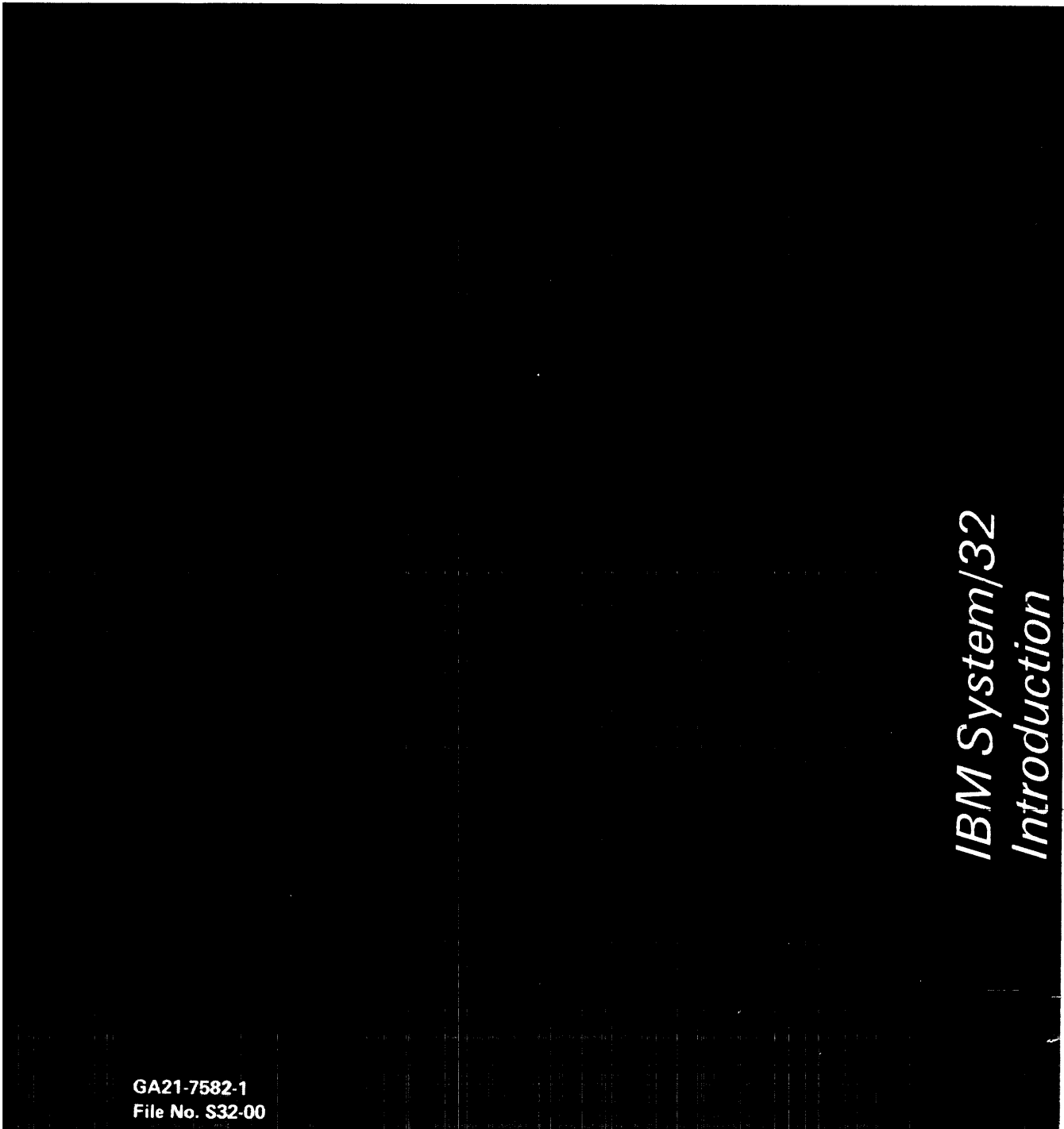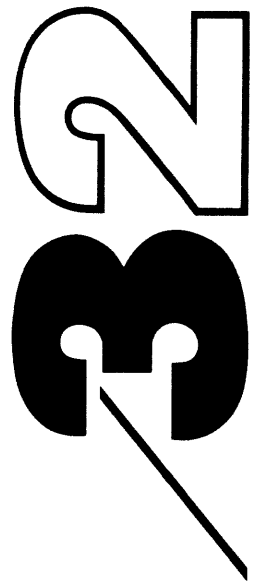SYSTEM /*3*2

32

IBM System/32
Introduction

*IBM System/32
Introduction
General Information*

IBM System/32
Introduction

Preface

This manual introduces IBM System/32, a general purpose computer designed for small, single-establishment enterprises and branch or suboffice locations of larger companies.

This introduction to IBM System/32 is intended for executives and supervisory personnel who want a summarized description of what System/32 is and how it can be used to meet an organization's information processing requirements. This manual can also serve as an introduction for people who will operate System/32.

The description of IBM System/32 given here is written for readers who have no, or very little, direct experience using a computer. The description includes:

- A brief overview of System/32

- A fundamental description of data processing concepts and computers in terms of System/32

- A functional description of System/32 models and special features

- A discussion and examples of System/32 operating characteristics

- A summary of IBM System/32 programming and services

At the back of this manual is a glossary. The glossary defines data processing terms introduced in this manual.

Note: First availability of the SDLC (synchronous data link control) feature, described under *Telecommunications Support* in Chapter 3, is planned for May, 1976.

Related Publications

Titles and abstracts of related publications are listed in the *IBM System/32 Bibliography,* GC20-0032.

Second Edition (May 1975)

Contents

The vigorous competition in today's marketplace is a challenge to every business. Despite high operating costs, business can meet the challenge through sound management and increased productivity.

Sound management and increased productivity both depend in part upon the efficient handling of business information. For example, executives require timely and accurate reports in order to make informed business decisions, and continuing cost analysis raises productivity by detecting wasted resources.

How can a small business with a limited staff cope with such critical demands for information? Today the small business can increase its ability to handle information by employing the same method larger businesses have used. The small business can now apply the capabilities of a computer data processing system to its data processing problems.
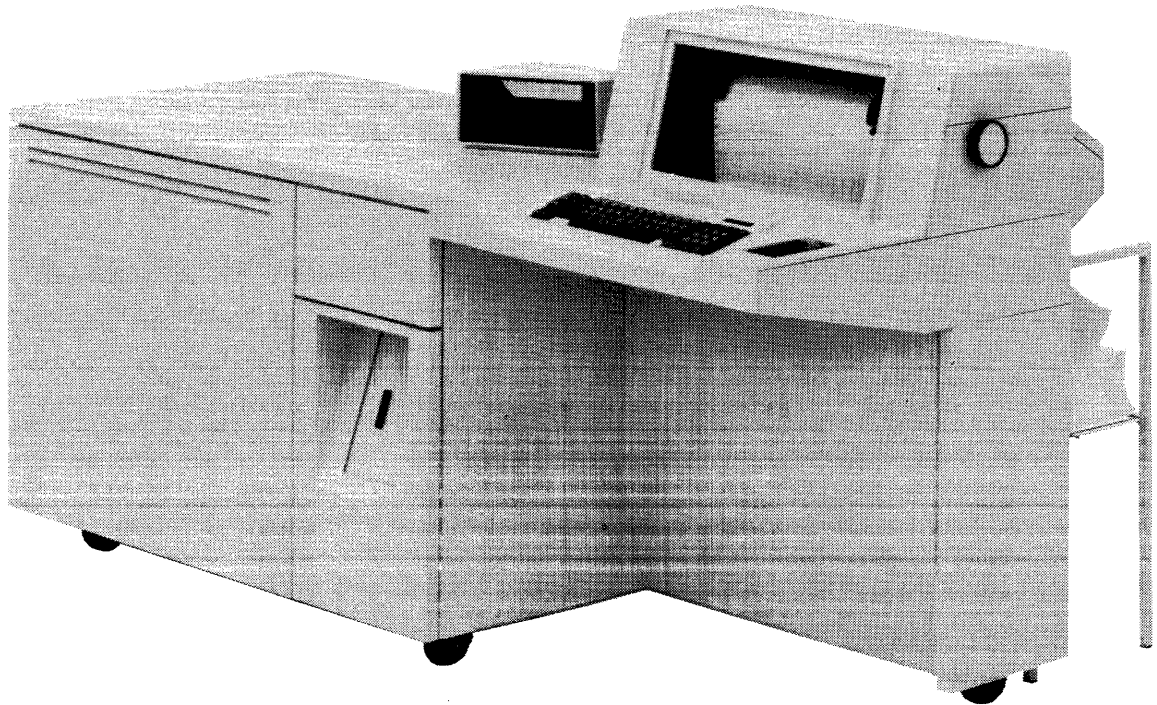
System/32

IBM System/32 is a general purpose computer designed to meet the data processing requirements of small, single-establishment enterprises and branch or suboffice locations of larger companies. The system is particularly suited to common business applications such as:

- Order writing

- Billing

- Accounts receivable

- Accounts payable

- General ledger

- Inventory control

- Payroll

- Sales analysis

System/32 performs data processing tasks with the speed, efficiency, and reliability typical of larger computer systems. Yet System/32 is appropriate for small offices because:

1. It is physically compact and convenient to install. The physical facilities needed to accommodate System/32 are minimal.

2. It is easy to operate. An experienced computer specialist is not required for the operation of System/32—one of your current employees can be trained to operate the system effectively.

3. It is supported in various industries by Industry Application Programs (IAPs). An IAP is an application program designed by IBM to meet selected data processing requirements existing within a specific business or industry. Where applicable, IAPs can eliminate the need for a professional programmer at your System/32 installation. Your IBM representative can tell you which IAPs are available.

Physical Characteristics

System/32 is about the size of an ordinary office desk and includes the following integrated components:

● *A processing unit.* The processing unit is the arithmetic/logic unit and the control center of the system.

● *Magnetic disk storage.* Magnetic disk storage places information on and reads information from magnetic disks, which can contain large quantities of information in very little space. System/32 magnetic disk storage consists of:
   - A disk that is used to store large data files for processing.
   - A diskette drive that records information on and reads information from magnetic disks called diskettes. Diskettes are a removable storage medium used to store information until it is required for processing.

● *A keyboard.* The System/32 keyboard is much like the keyboard of a standard typewriter. The operator uses the keyboard to enter—key—information into the system.

● *A display screen.* The display screen looks like a small television screen and is used by the system to display information to the operator.

● *A printer.* The printer provides printed information from the system.

Processing
Unit   Display Screen   Keyboard   Printer

Disk   Diskette Drive

Magnetic Disk Storage
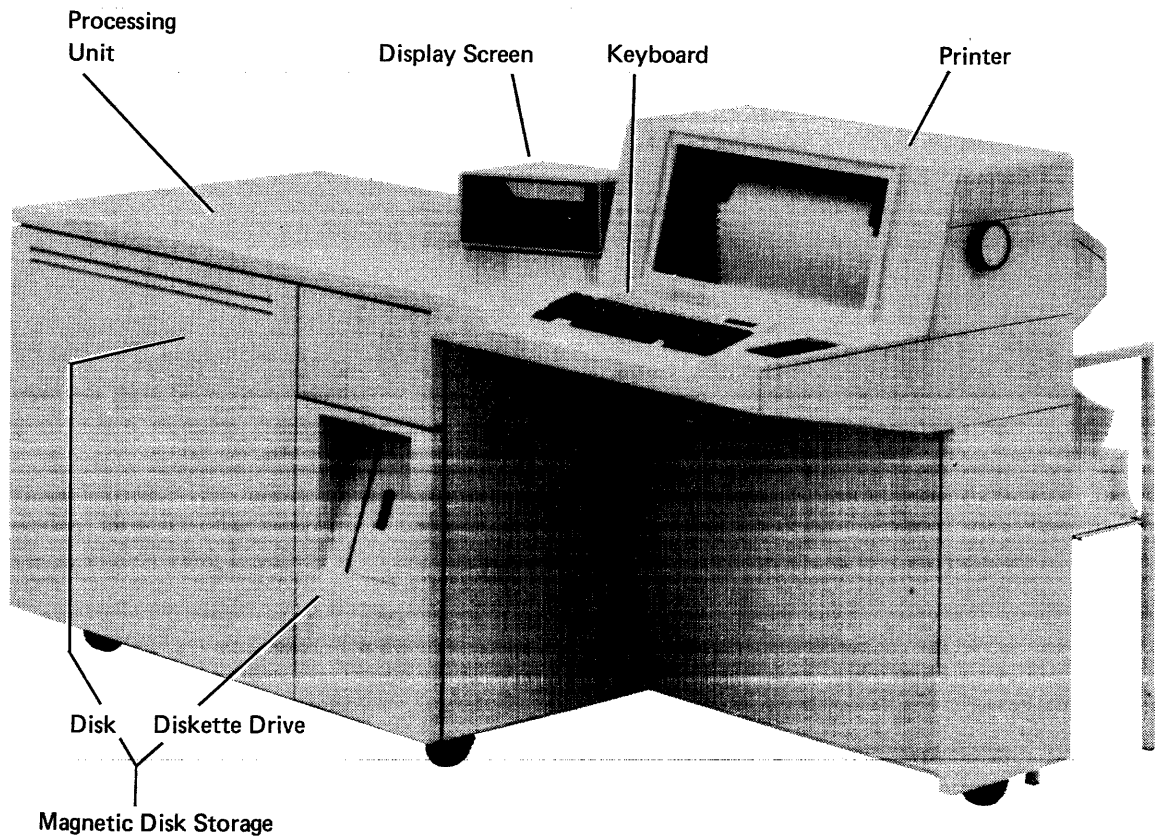
System/32 requires few physical facilities. Besides operating space, the only physical requirement of System/32 is access to one grounded 208/230-volt outlet for system power and one grounded 115-volt outlet for IBM testing equipment. Normal office air conditioning is recommended for operator comfort, but, except in extreme operating environments, air conditioning is not required for the system.

Operating Characteristics

Just as the installation of System/32 places few demands upon the physical facilities of your office, so too the operation of System/32 requires no additions to your professional staff.

System/32 is designed for the operator who has never run a computer. Many operating aids are featured in the design of System/32 to eliminate any requirement that the operator be a computer data processing professional. Basic knowledge of fundamental computer data processing concepts, plus training on System/32, is sufficient background for confident operation of the system. Frequently an employee responsible for bookkeeping or other clerical duties can, after successfully completing IBM's System/32 operator training program, be expected to assume responsibility for operating System/32.

Among the System/32 operating aids are:

- *Familiar keyboard design.* The System/32 keyboard contains the keys found on the standard typewriter keyboard. The keyboard also contains a cluster of ten numeric keys arranged in the standard adding machine fashion. These familiar key arrangements facilitate rapid keying of information by the System/32 operator.

- *Keyboard function and command keys.* The System/32 keyboard contains easily identified function keys and command keys. By using the function and command keys, the System/32 operator can request specific system functions and processing applications. The particular function associated with a command key can be assigned by the application programs used on the system.

- *Simplified control statements.* The System/32 operator can control system operation by keying short, simple control statements. These statements, called command statements, are composed of familiar, everyday terms and let the operator avoid the highly technical control language normally required by a computer system.

- *System utility programs.* Provided with System/32 is a comprehensive set of system utility programs. The system utility programs perform routine tasks required by every data processing system. For example, the SAVE utility copies selected information from the disk to a diskette, thus enabling an operator to make extra copies of particular information for audit and control or for mailing to other locations.

- *Continuous system-to-operator communication.* The display screen provides a ready communication link between System/32 and the operator. Information is displayed on the display screen as it is keyed on the keyboard in order to help the operator verify information before it is used by the system. System messages are also displayed on the display screen. These messages—brief, clear, and precise—are displayed by System/32 to guide the operator through applications, to request specific information required to complete a job, and to help the operator identify keying errors detected by the system.
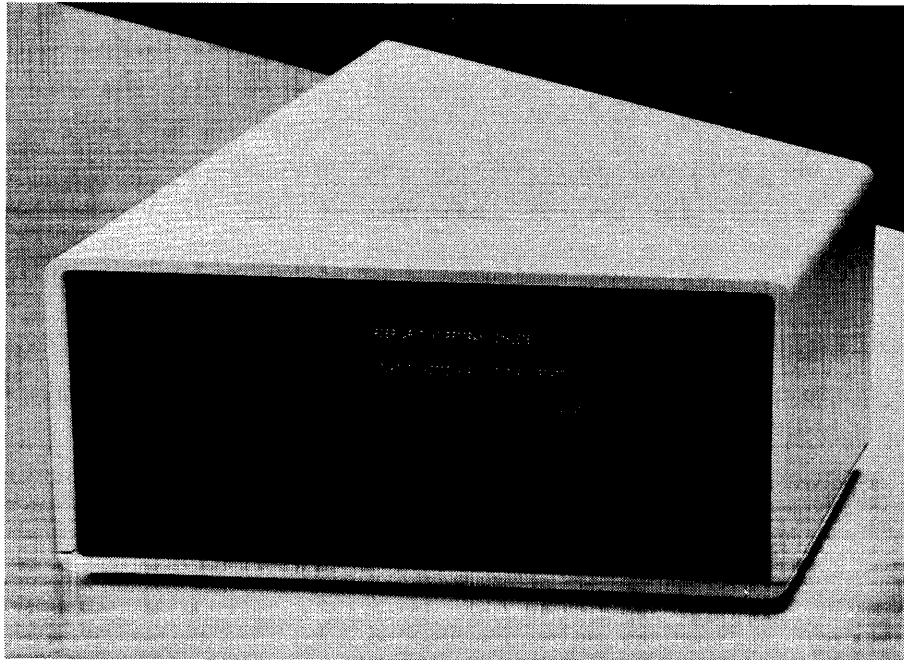
Chapter 2. IBM System/32 in Perspective

This chapter provides background information to help you place IBM System/32 in the perspective of your own data processing requirements. It sketches the history of modern data processing systems, relates the principles of data processing to computers, and describes the parts of a computer in terms of System/32. The advantages of using a computer to process data are reviewed at the end of the chapter.

DATA PROCESSING

Though data processing may imply the presence of a computer, the term itself describes an activity that is as old as commerce: performing a series of planned actions (processing) upon information (data) to achieve a desired result. The result may be new information or the original information expressed in a more appropriate form. For example, adding a list of prices to discover the total cost is data processing. Preparing an invoice from a telephoned order is also data processing.

Commercial data processing has changed with the demands of doing business. As long as the number of transactions of a business remains small, and as long as the transactions are of little variety, one clerk can prepare all invoices, keep the accounts receivable up to date, control inventory levels, and so on. As a business grows, however, its transactions become more numerous and complex, and management often requires more information more readily in order to make necessary business decisions. In other words, data processing requirements have grown with business. Data processing methods have had to change as well.

Electronic Data Processing

The most recent innovations in data processing methods are incorporated in electronic data processing systems—computers. An electronic data processing system is an organization of equipment and procedures that can process huge amounts of data at electronic speeds. The evolution of such systems can be traced from manual data processing methods, through the introduction of mechanical bookkeeping machines and punched card devices, to the computer. Today the terms *electronic data processing, data processing,* and *computer data processing* are often used interchangeably.
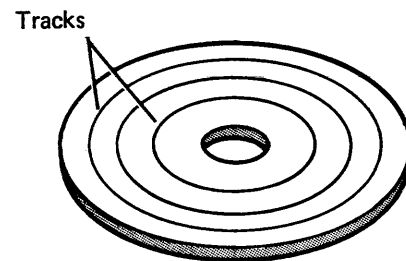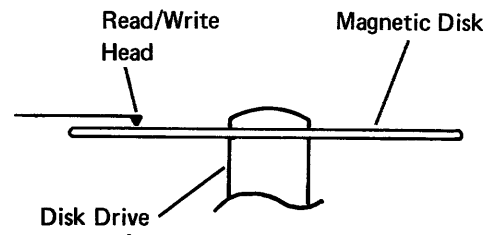
Magnetic Disk Storage

The evolution of data processing systems is traced not only by different kinds of machines, but also by different forms of data storage. One business may keep its records in handwritten journals, another on machine-posted ledger cards, another in punched cards, and another on magnetic tapes or disks.

Magnetic Disks

Many modern computers record data on magnetic disks. A magnetic disk is a thin, round plate coated with a magnetic material. Data is recorded on the magnetic coating in the form of magnetized spots.

The way data is recorded on a magnetic disk is essentially the same on all computers—the physical recording, or writing, of data is performed by a mechanism called a read/write head. The read/write head is moved over the surface of the disk as the disk spins on the disk drive. Since the disk spins continuously while data is being recorded, data is arranged on the disk in concentric circles. Each circle is called a track.

Read/Write Head

Magnetic Disk

Disk Drive

Tracks

Read/write heads read as well as record data. A read/write head reads data from a magnetic disk without affecting any of the data stored there. However, new data can be recorded over obsolete data as required. Because the data stored on a magnetic disk can be so readily changed, magnetic disks—unlike journals, ledger cards, and punched cards—are reusable.

Disk Data Files

When data is recorded on a magnetic disk, it is organized into files. That is, related business records are collected in distinct groups—files—that are assigned unique names, much as a bookkeeper might collect all customer credit information in a labeled drawer of index cards. Similarly, a computer that stores data on magnetic disks can easily locate individual records in different files, just as a bookkeeper who uses index cards can.

System/32 records data on a disk and on diskettes. The disk is an integral part of System/32 and is used primarily for storing the system utilities and other programs that are often run, and for storing large volumes of frequently processed data. For example, you would store data files such as accounts receivable and master inventory files on the disk.

A diskette is a small, flexible magnetic disk permanently enclosed in a protective jacket. Unlike the disk, diskettes are removable. That is, when data is to be copied from the disk to a particular diskette or copied from a diskette to the disk, the diskette is placed in the System/32 diskette drive, a control statement is entered to initiate copying, the required data is copied, and the diskette is removed from the drive when copying is complete. Because they are removable, diskettes extend the magnetic disk storage capacity of System/32—the amount of data you can store on diskettes is limited only by the number of diskettes available. Because they are also easy to handle and easy to store, diskettes are convenient for copying information to mail to other data processing locations and for copying information to store for audit and control or for future processing.

Another significant advantage of diskettes is their interchangeability with other IBM systems. The diskettes used on System/32 are the same as those used on the IBM 3740 Data Entry System and on IBM System/370. Diskettes thus provide an economical medium for exchanging data between System/32 and other systems.

The interchangeability of diskettes with the IBM 3740 Data Entry System also helps you adapt System/32 to growing data processing requirements. As the volume of data to be processed by System/32 increases, you can use the IBM 3741 Data Station or the
| IBM 3741 Programmable Work Station (both a part of the IBM 3740 Data Entry System) to record data on diskettes at the same time System/32 is processing other data.

Data Entry

IBM 3741

IBM
Diskette

Data Processing
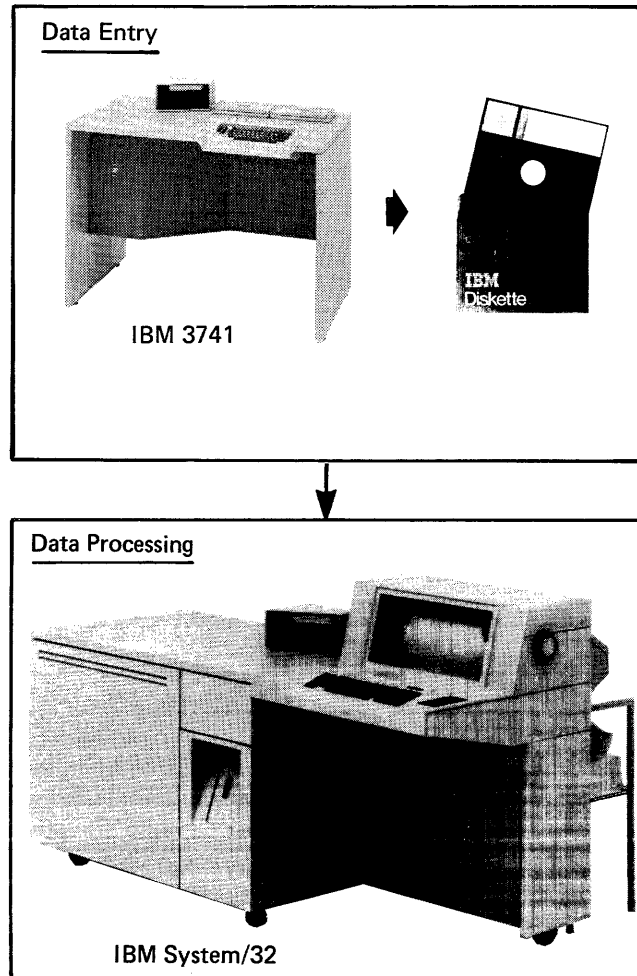
IBM System/32

For example, data recorded on a diskette by an IBM 3741 can be read from the diskette by System/32 in a matter of seconds, and the IBM 3741 can be recording more data while System/32 processes data recorded earlier. Consequently, though the amount of business data you want to process will increase with the size of your business, by using an IBM 3741 for data entry you can reduce System/32 data entry time and increase the amount of data System/32 can process in each working day.

For more information on the IBM 3741 and other devices in the IBM 3740 Data Entry System, ask your IBM representative for *IBM 3740 Data Entry System System Summary and Installation Planning,* GA21-9152.
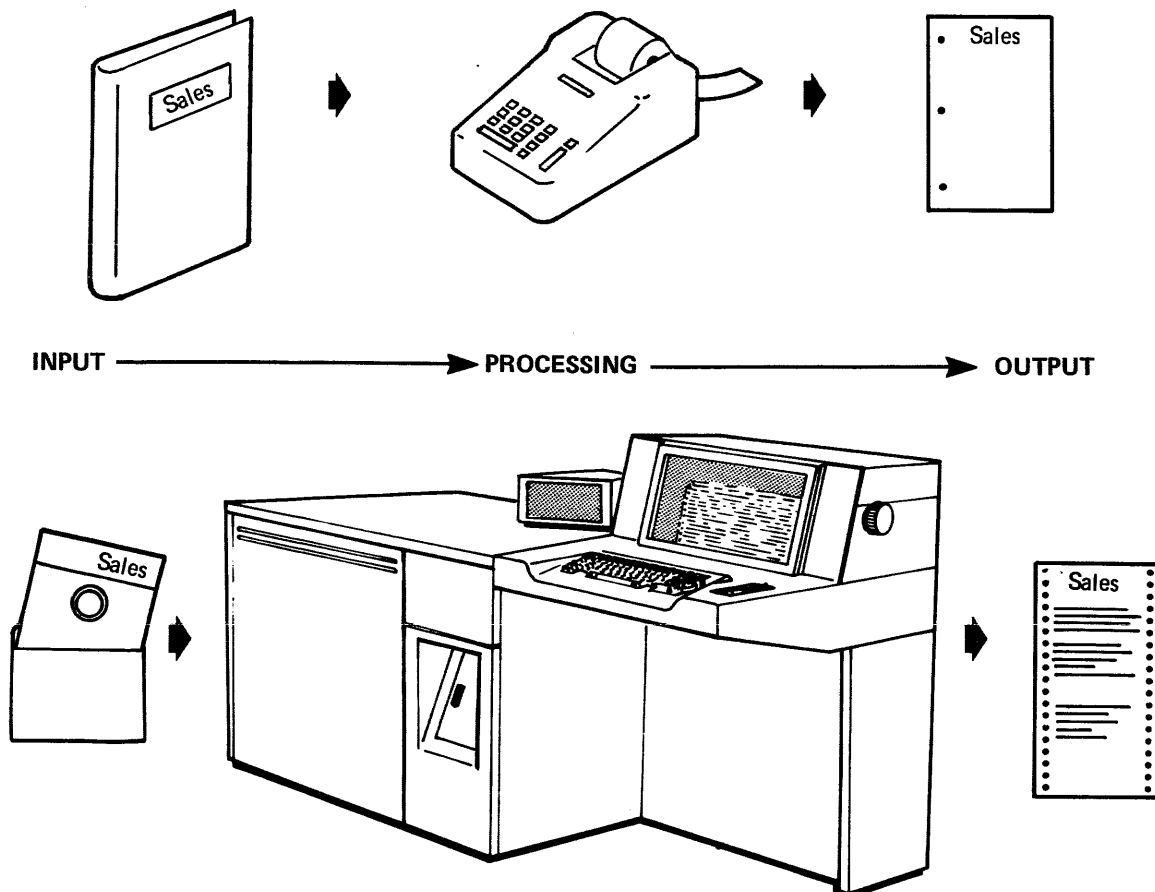
Input, Processing, and Output

Though modern data processing systems have become very sophisticated, processing data by computer and recording daily transactions by hand still share the three elements fundamental to all data processing: input, processing, and output.

- *Input.* Input is data to be operated on—processed.

- *Processing.* Processing is the handling of input according to specific instructions or rules.

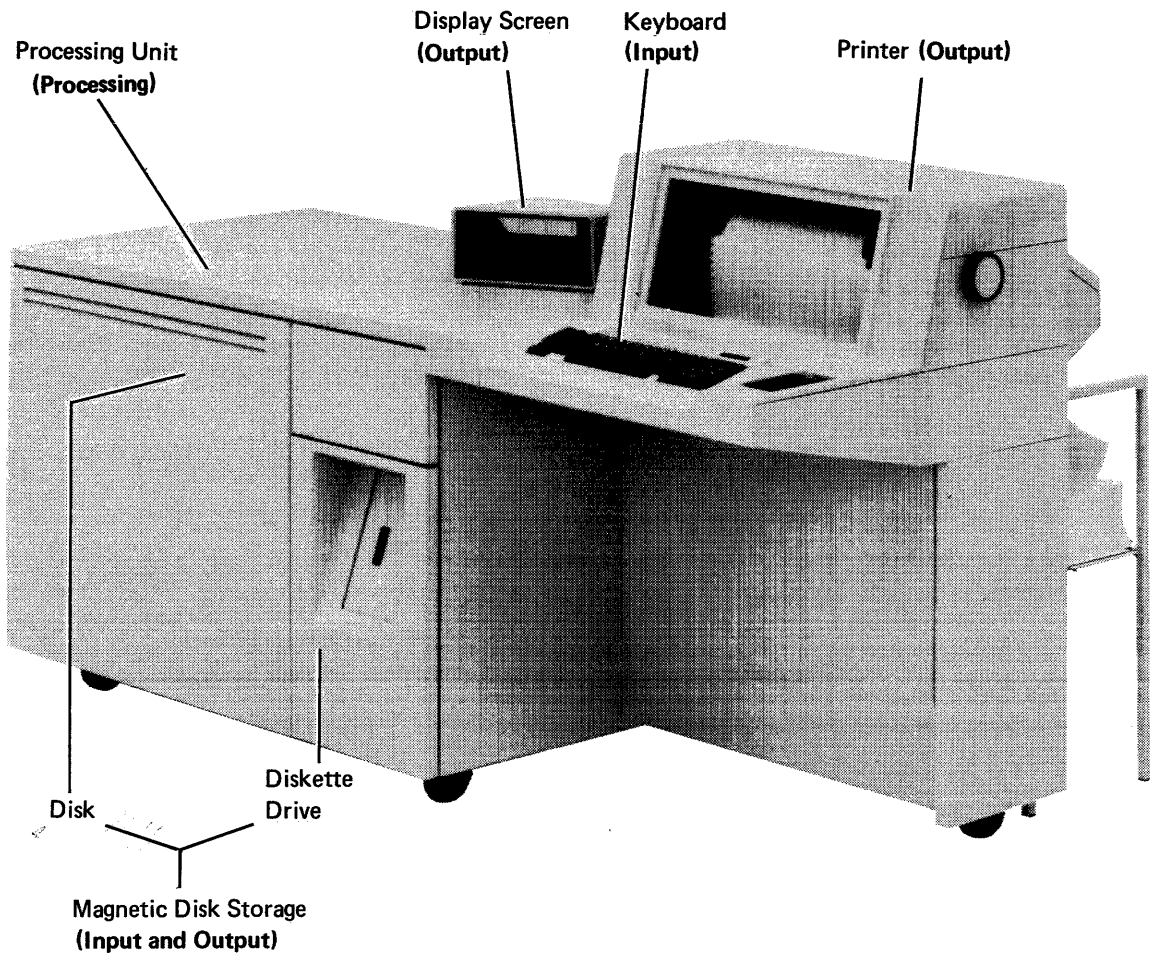- *Output.* Output is the result of processing the input.

Suppose two clerks are given the same problem: add all receipts for the last month to produce a sales report. And suppose that one clerk uses an adding machine and the other clerk uses a computer.

- *Input.* In our example, a record of the month's sales is the input, whether that record exists in a handwritten register or is a data file on a magnetic disk.

- *Processing.* Both clerks must add input to obtain a sum, and both the adding machine and the computer must operate according to the rules of addition and be used to achieve specific results for a particular job.

- *Output.* The output in our example is a sum that represents sales revenue, whether the sum is presented in a hand-drawn chart or a report printed by the computer.

INPUT ⟶ PROCESSING ⟶ OUTPUT

COMPUTERS

The fundamental data processing concept, *input, processing, and output,* is reflected in the physical makeup of every computer.

Processing Unit
(Processing)

Display Screen
(Output)

Keyboard
(Input)

Printer (Output)

Disk

Diskette
Drive

Magnetic Disk Storage
(Input and Output)

Input

Every computer must provide the operator some way to get information—input—
into the system for processing. On System/32 input can be entered from the key-
board or read from magnetic disk storage. To accomplish order writing, for example,
the operator can enter order information from the keyboard for immediate process-
ing or use the keyboard to place the input on the disk or a diskette, where it is stored
until required.

If orders are to be processed immediately, processing begins as soon as the operator keys
enough data for System/32 to begin processing an order. The system processes addition-
al data as it is entered. If the operator keys data faster than System/32 can process it,
the data is temporarily stored, then processed when the system is ready for it. Thus data
can be keyed at the operator's best speed regardless of processing speed. This method of
processing, whereby the system continuously processes the data for a job as the operator
enters the data, is called interactive processing.

On the other hand, the operator can use the keyboard to record on the disk or a
diskette all the data required for a particular group of orders, then instruct System/32
to read the data and prepare all the orders at once. This method of processing,
whereby all the data for a job is submitted in a single group, or batch, is called batch
processing.

Processing

Every computer has a processing unit. The processing unit controls the system and
manipulates data. It monitors the flow of information into the system, performs
calculations and other operations on data, and regulates the flow of output.

But the processing unit must be told exactly where to find input, how to operate on
input, and what to do with output. Such directions are given to the processing unit
in the form of computer programs. A computer program is a sequence of precise
instructions written in a special form the computer can interpret. Before a computer
performs any data processing, a program explaining where to find input, how to operate
on the input, and what to do with output is read into the processing unit.

Programs are read into an area of the processing unit known as main storage. Main
storage is the processing unit's work area. Input, programs, and output are moved in
and out of main storage in whatever manner each particular data processing job re-
quires. However, each data processing job always requires two distinct programs
operating together—each job requires an application program and a system control
program.

Application Program

An application program specifies distinct operations to be performed on specific in-
put to obtain unique output. A program directing a computer to update accounts
receivable according to input provided by the operator is an example of an applica-
tion program. A program instructing a computer to print a sales report based on a
particular transactions file is another example of an application program. In other words,
application programs operate directly on data to meet specific data processing require-
ments.

12

System Control Program

Like all computer programs, a system control program is a sequence of instructions to a computer. Unlike an application program, a system control program does not operate directly on data to obtain unique results. Rather, a system control program controls the movement of data through the system as the system carries out the instructions specified in an application program. This control is provided for all application programs, despite the variety of data processing functions performed by the application programs.

For example, if an application program specifies calculations involving data stored on a magnetic disk, the system control program transfers the data to main storage. The system control program also transfers output from main storage to the printer if an application program specifies printed output.

System control programs also interpret and respond to requests made by the operator. If the operator requests that a certain application program be run, the system control program reads it into main storage. Similarly, the system control program reads system utilities into main storage as the operator requests them.

The more control provided by a system control program, the more attention the operator can devote to specific applications. The System/32 system control program provides comprehensive system control. It also simplifies system operation by being flexible enough to interpret operator requests whether they are specified by keyboard function or command keys or by command statements, and aids the operator by displaying information on the display screen to keep the operator informed of each application's progress.

The IBM System/32 system control program is supplied with the system. It is stored on the disk.

Output

Every computer system must include some means of providing output to the operator. System/32 can store output on a magnetic disk, display output on the display screen, and print output on the printer.

You can print output in the format best suited to each application. System/32 can, for instance, print on forms of different kinds and sizes, such as paychecks and invoices, and can print different kinds of reports, such as cost analysis reports and sales reports, in different formats as they are defined by your application programs.

ADVANTAGES OF COMPUTER DATA PROCESSING

If data processing is always a matter of input, processing, and output, how is computer data processing different from manual or mechanical data processing? Computers process large volumes of data faster, more accurately, in less space, and with greater versatility.

- *Speed.* Because computers process data electronically, they operate at remarkable speeds that save a tremendous amount of time. System/32 can copy over 1,800 128-character records from a diskette to the disk in about one minute, and can print reports at the rate of 155 lines per minute.
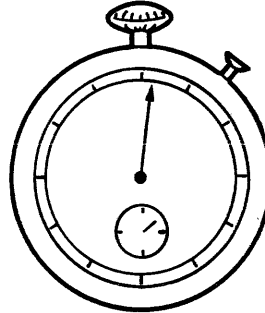
- *Accuracy.* A computer does exactly what it is told to do and only what it is told to do. Because of this constant dependence on instructions, a computer follows program after program, second after second and hour after hour, with unvarying accuracy.

  Computers also reduce transcription errors by dramatically reducing the need for manual transcription. Once the System/32 operator records data on a magnetic disk, that data may never have to be written by hand again—you can update as many different files, complete as many different kinds of forms, and create as many different reports from that data as you have application programs that use the data. By referring to the display screen while first record ing the data, the System/32 operator can ensure that the data is keyed correctly. And application programs that use the data can perform checks and balances to continually validate the accuracy of the data.

- *Data Compression.* Computers miniaturize data. Suppose a business enters its accounts receivable transactions in a machine-posted register like the one shown below.

```
                    ACCOUNTS RECEIVABLE TRANSACTION REGISTER

                             07/11/--                            PAGE 001


           CUST       CUSTOMER      JOURNAL   INVOICE   CASH    INVOICE   JOURNAL
   DATE    NO         NAME          NO        NO        AMOUNT  AMOUNT    AMOUNT

 07/11/--  759820  SOUND OF THE SEVENTIE     063420            $ 46.23
 07/11/--  633870  OLDE VILLAGE SHOPPE       063421              89.70
 07/11/--  642990  PARAGON TV SALES          063422              20.30
 07/11/--  122620  CANNIZONI STUDIOS         063423             129.76
 07/11/--  682030  RAYMONDS RAPID REPAIR              $ 63.80
 07/11/--  742950  SARATOGA VARIETY                    29.72
 07/11/--  014280  BAKER BRADLEY & CO.                 43.50
 07/11/--  872060  UNIVERSITY ELECTRIC                 97.75
 07/11/--  883290  VILLAGE MUSIC & TV   07-036                            $18.23CR
 07/11/--  006280  ALLSTONS             07-037                             10.70CR

                   TOTALS                           $234.77* $285.99*    $28.93CR*
```
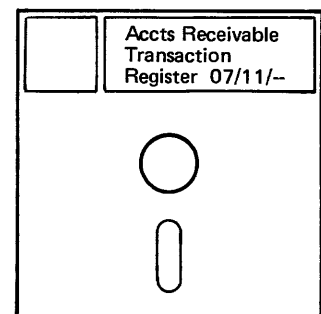
The preceding example shows ten sample entries, or records. Nearly 1,900 such transaction records can be stored by System/32 on one diskette. That is, System/32 enables you to store large volumes of business information in an economical and manageable form that can be processed by a machine.

ACCOUNTS RECEIVABLE TRANSACTION REGISTER

07/11/--   PAGE 001

DATE	CUST NO	CUSTOMER NAME	JOURNAL NO	INVOICE NO	CASH AMOUNT	INVOICE AMOUNT	JOURNAL AMOUNT
07/11/--	759820	SOUND OF THE SEVENTIE		063420		$ 46.23	
07/11/--	633870	OLDE VILLAGE SHOPPE		063421		89.70	
07/11/--	642990	PARAGON TV SALES		063422		20.30	
07/11/--	122620	CANNIZONI STUDIOS		063423		129.76	
07/11/--	682030	RAYMONDS RAPID REPAIR			$ 63.80		
07/11/--	742950	SARATOGA VARIETY			29.72		
07/11/--	014280	BAKER BRADLEY & CO.			43.50		
07/11/--	872060	UNIVERSITY ELECTRIC			97.75		
07/11/--	883290	VILLAGE MUSIC & TV	07-036				$18.23CR
07/11/--	006280	ALLSTONS	07-037				10.70CR
		TOTALS			$234.77*	$285.99*	$28.93CR*

Accts Receivable
Transaction
Register 07/11/--

● *Versatility.* The number of different tasks a computer can do is limited only by the number of different programs run on it. The computer can do much more than just add, subtract, multiply, and divide. System/32 can, for example, prepare invoices, keep accounts receivable up to date, print weekly paychecks, and analyze huge amounts of data for thorough cost and sales analysis.

Speed, accuracy, data compression, and versatility combine to reduce data processing errors and increase productivity. But a less obvious advantage of computers has a more fundamental effect.

Computers impose discipline. As explained, a computer is helpless without programs—it cannot think for itself. Neither can a computer guess whether its programs really reflect the problems at hand—you must see that they do. In other words, you must carefully analyze the data processing requirements of your organization in order to take full advantage of a computer. For instance, with the data processing capabilities a System/32 would provide, what additional cost analysis, inventory control, and auditing procedures would you like to implement in your organization?

The responsibility for analyzing an organization's data processing requirements falls, of course, to management. But the discipline imposed by a computer extends throughout the data processing activities of the organization. Once you've designed or selected computer programs that reflect management directives, you've established management control that is automatically practiced each time those programs are used.

IBM System/32 is available in different models. The models vary in magnetic disk storage capacities and printing speeds, and can feature different main storage capacities. However, each model of IBM System/32 is a complete data processing system—each model can accept input, process input, and provide output. This chapter describes in more detail how the functions of accepting input, processing input, and providing output are performed on System/32.

To help you select the System/32 model best suited to your data processing needs, a model summary is given at the end of this chapter.

INPUT

System/32 accepts input keyed on the keyboard or reads input from the disk or diskette drive.

Keyboard
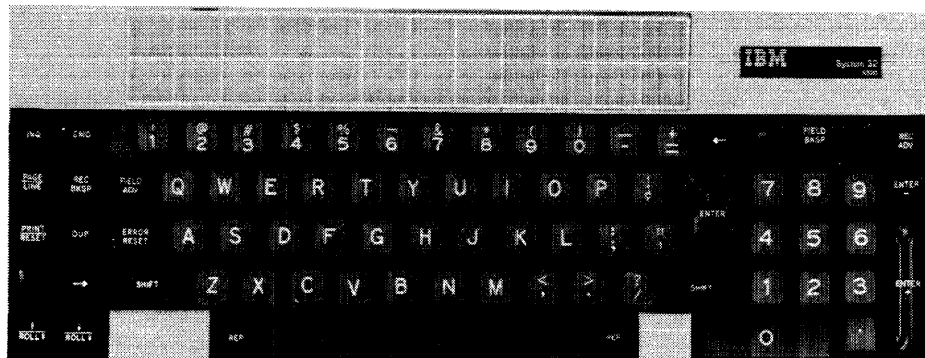
The operator uses the keyboard for entering data, control information, and requests for system functions. The keyboard contains:

- Standard typewriter keys for entering alphabetic and numeric data and control information

- A cluster of ten numeric keys for entering numeric-only data

- Function keys for requesting certain system functions

In addition, twelve of the standard typewriter keys can be defined as command keys to control program functions.

Disk
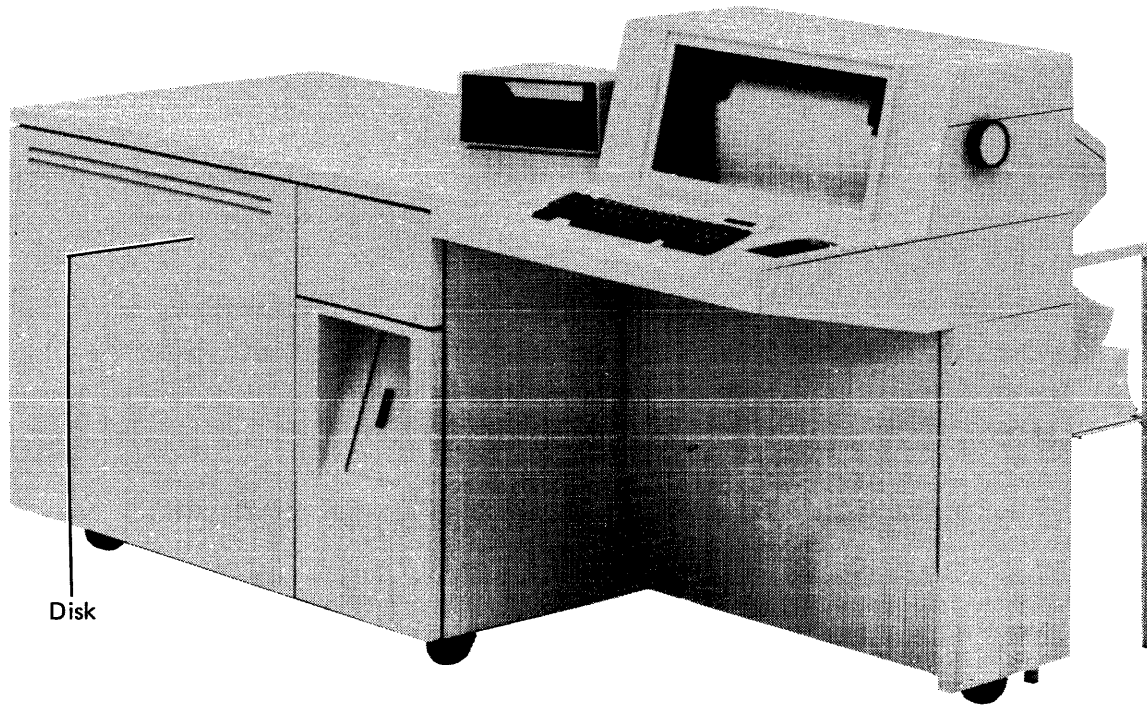
Disk

The disk provides magnetic disk storage for the IBM System/32 system control program and for system utility programs, application programs, and data files. Data stored on the disk is read into main storage for processing whenever the data is required as input. The disk cannot be removed from the system.

Storage Capacity

The storage capacity of a magnetic disk is measured in bytes—one byte can hold one character of information. Different disk capacities are available on different models of System/32. The capacities available are:

5,053,440 bytes

9,169,920 bytes

Before you decide how much storage space you need on the disk, consider how much disk storage space is required to hold your most frequently processed data files. If input for a job is on a diskette, System/32 must move the data to the disk before reading it into main storage for processing. The time required to move the data from a diskette to the disk is saved if the input is already on the disk. Therefore, if your most frequently processed data files are stored on the disk, many of your data processing jobs will be done faster than if those files were all stored on diskettes.

Speed

Access time on the disk is the time required to find a specified disk area of 256 bytes. The average disk access time for a file using one-third of the disk's capacity is, in milliseconds (one thousandths of a second):

Capacity in Bytes	Average Access Time
5,053,440	80.1 milliseconds
9,169,920	82.6 milliseconds

Information is written on and read from the disk at the nominal rate of 889,000 bytes per second.

Diskette Drive
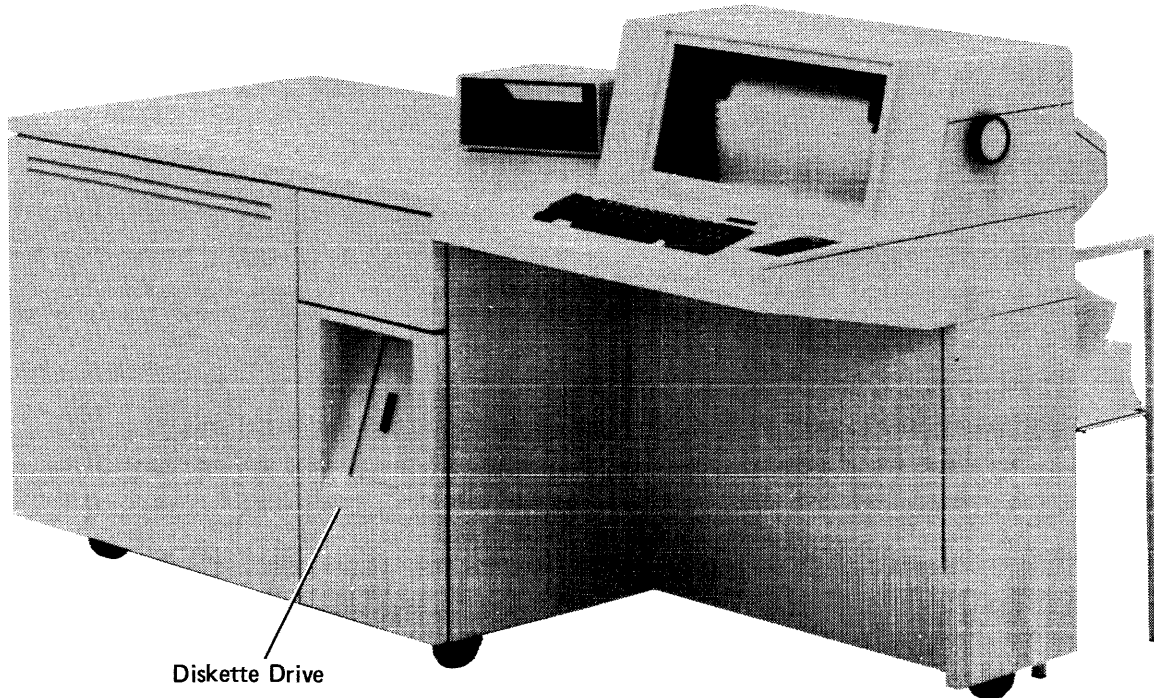
Diskette Drive

The diskette drive serves to enter input by enabling the system control program to read information from IBM diskettes to the disk. The information can then be read from the disk into main storage for processing. The diskette drive also enables you to take advantage of the interchangeability of diskettes.

Storage Capacity

Diskettes to be exchanged between System/32 and other systems can contain 242,944 bytes of data. Diskettes to be used exclusively on System/32 can contain 246,272 bytes of data or, if data is recorded in the 512-byte extended format, 303,104 bytes of data.

Speed

The nominal data transfer rate of the diskette drive is 31,250 bytes per second. The diskette drive reads 128-byte records from a diskette and writes 128-byte records to a diskette at the following rates:

	Using Diskettes in the Standard Interchange Format	Using Diskettes in the 512-Byte Extended Format
Reads	Up to 3,400 records per minute	Up to 4,100 records per minute
Writes	Up to 1,800 records per minute	Up to 2,200 records per minute

PROCESSING
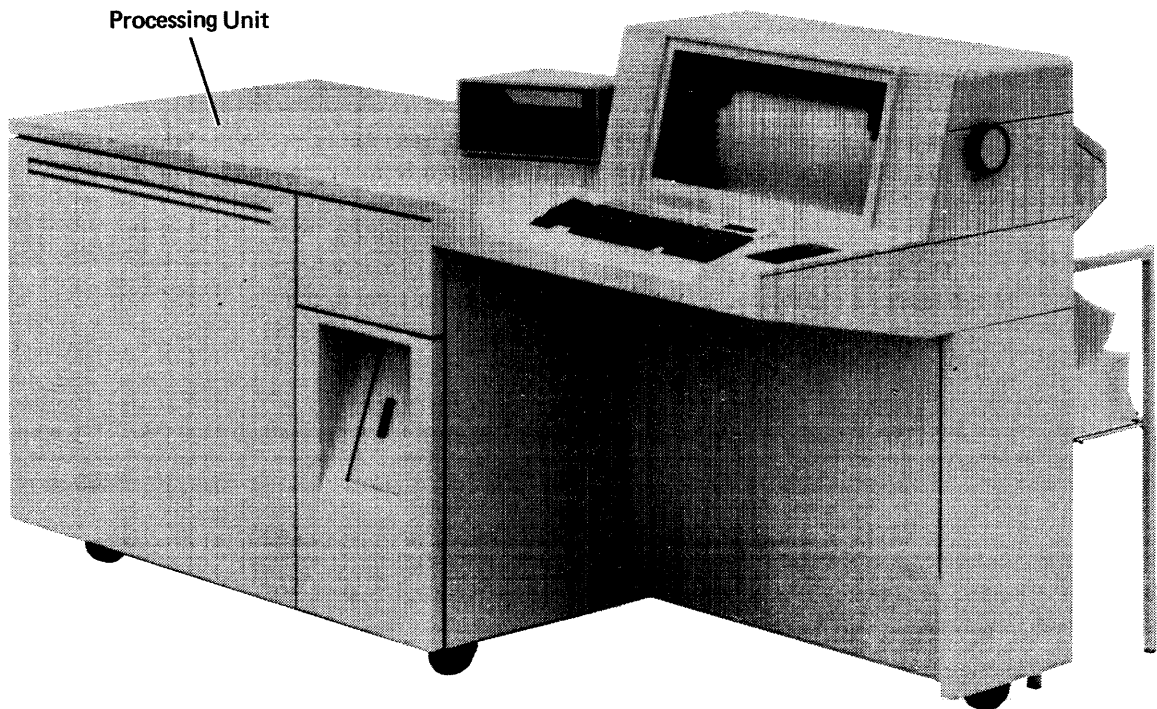
Processing Unit

The processing unit contains the system's arithmetic/logic unit, control section, and main storage area. The main storage area holds the program instructions for a job and the data to be processed during that job. Like magnetic disk storage, System/32 main storage is measured in bytes. Each model of System/32 is provided with 16,384 bytes of main storage. Additional main storage can be ordered to increase the capacity to 24,576 bytes or 32,768 bytes.

The control section of the processing unit coordinates and controls the entire system. It retrieves instructions and data from main storage and, in conjunction with the system's arithmetic/logic unit, performs the operations specified by the instructions.

The control section supports input/output overlap. That is, selected input, processing, and output operations occur simultaneously. For example, as more data is being located on the disk, the processing unit can be performing calculations and the printer can be printing the results of previous calculations. This overlap of functions increases the speed with which the system completes each job.

OUTPUT

System/32 provides output on the disk, diskette drive, display screen, or printer.

Disk and Diskette Drive

The disk and diskette drive both serve a dual purpose: each can be used to provide input to a program and each can be used to store output from a program.

System/32 can record output on the disk just as the operator can record input on the disk. Output recorded on the disk can be stored on the disk indefinitely or can be transferred to a diskette—just as the diskette drive can be used to transfer input from a diskette, so too the drive can be used to transfer output to a diskette.

Display Screen
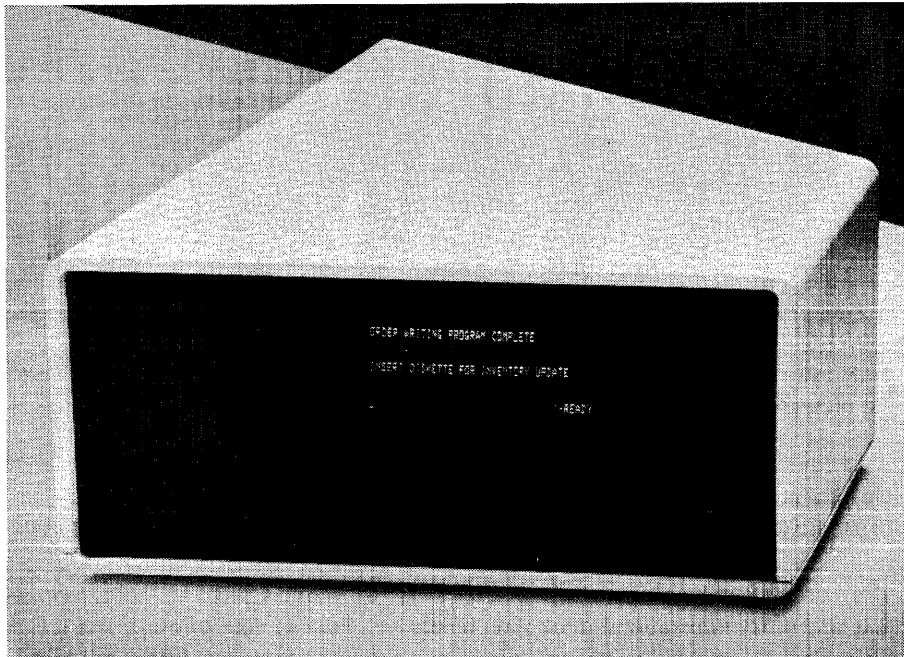
The display screen displays output and can be used to display records stored in disk files. In addition, System/32 uses the display screen to communicate with the operator. For example, System/32 displays:

● Information keyed on the keyboard, as it is keyed, so the operator can verify the information before the system acts upon it

● Messages that identify keying errors, provide operator guidance, and request specific processing information as it is required

The display screen can display as many as six lines of information, 40 characters per line, at a time.

Printer

A printer is incorporated in each model of System/32 to provide printed output. The format of printed output is defined by the program that produces the output.

Different printing speeds are available on different models of System/32. A choice is offered because the amount of printed output required of a data processing system varies with the kind of work performed on the system. If many of your data processing jobs require extensive printing, such as the printing of lengthy reports, one of the faster printing speeds may increase the efficiency of your system.

Two kinds of System/32 printers are available: a serial printer and a line printer.

Serial Printer
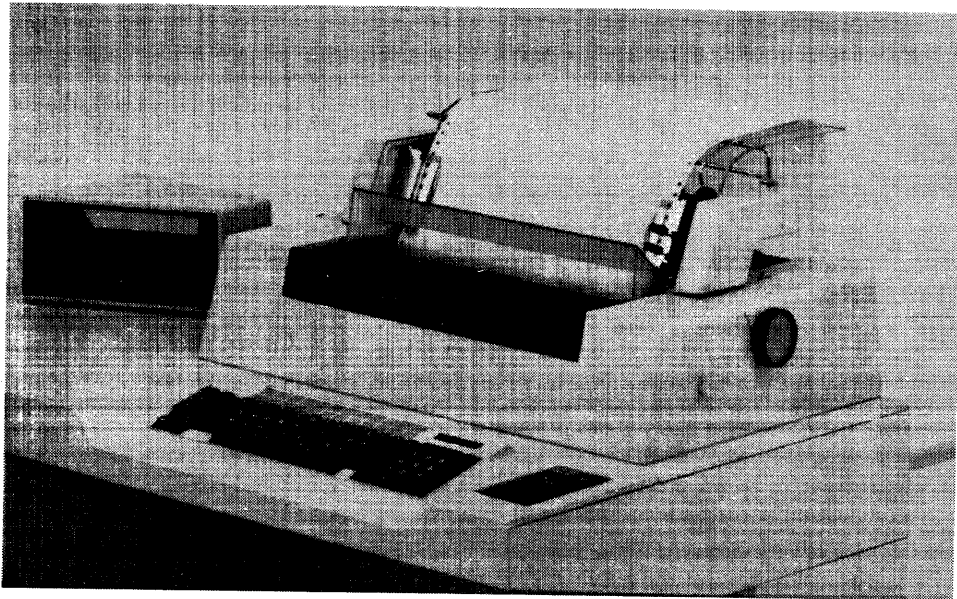
The serial printer forms characters from dot patterns. It can print an original and multiple carbon copies. The number of carbon copies that can be printed and the print quality of the carbons depend on the weight and quality of the paper and carbon paper used. Six-part forms composed of one original and five carbon copies can be used, though the recommended maximum is a four-part form. Five- and six-part forms should be tested for satisfactory print quality and printer operation before the forms are used.

The serial printer can process precut forms of various sizes. The operator can insert precut forms such as ledger cards into the serial printer one at a time, in much the same way as a typist inserts forms in an IBM SELECTRIC® typewriter.

The serial printer spaces lines vertically at six lines per inch (25.4 mm). It can print as many as 132 characters per line. Characters are spaced ten characters per inch (25.4 mm).

The characters printed by the serial printer are defined in a character set. The character set contains 64 different characters and will meet the requirements of most business applications.

Printing speeds available on the serial printer are: 40 characters per second and 80 characters per second. The number of lines printed per minute varies with line length.
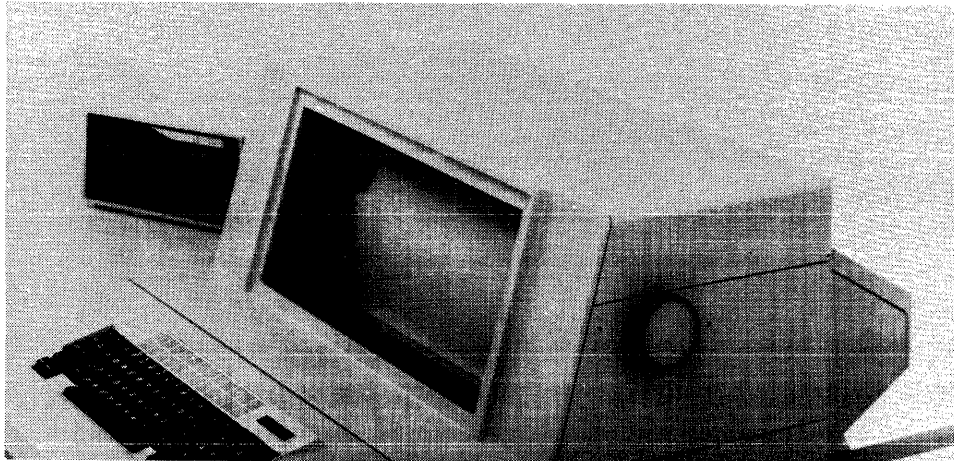
The line printer prints characters from an embossed print belt. It can print an original and multiple carbon copies. The number of carbon copies that can be printed and the print quality of the carbons depend on the weight and quality of the paper and carbon paper used. The recommended maximum is a six-part form composed of one original and five carbon copies.

The line printer spaces lines vertically at six lines per inch (25.4 mm). It can print as many as 132 characters per line. Characters are spaced ten characters per inch (25.4 mm).

A number of character sets are defined for the line printer. Each character set is represented on a print belt. Standard 48-character and 64-character print belts are available to meet the requirements of a variety of applications. Because print belts are interchangeable, the operator can select the character set best suited to each job.

Printing speeds available on the line printer are:

Nominal Print Speed in Lines per Minute

48-Character Set	64-Character Set
50	50
100	100
155	120

OPERATOR PANEL
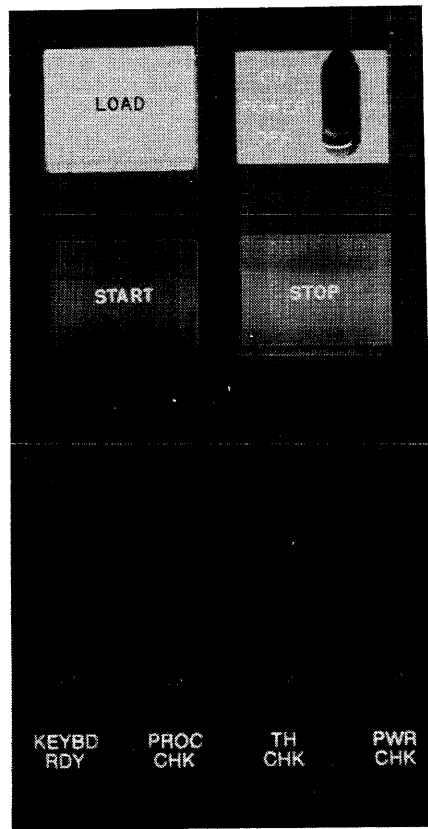
A panel of operator controls is part of IBM System/32. The panel is at the right of the keyboard and contains:

- The system's power on/off switch

- LOAD and STOP keys for initiating and interrupting system operation

- The START key, used by the operator to restart an interrupted job and lighted by the system to indicate that a job is in process

- The KEYBD RDY (keyboard ready) indicator light

- PROC CHK (processor check), TH CHK (thermal check), and PWR CHK (power check) indicator lights for signaling system conditions

SPECIAL FEATURES

Keylock Power Switch

This feature—available on all models of System/32—is a key-operated power switch that replaces the power on/off switch on the operator panel. When the key is inserted in the switch and turned, power is supplied to the system. The keylock power switch helps you restrict the use of the system to employees who have a key.

Additional Main Storage

Each model of System/32 is provided with 16,384 bytes of main storage. Additional main storage can be ordered to increase the capacity to 24,576 bytes or 32,768 bytes.

Telecommunications Support

The BSCA (binary synchronous communications adapter) and SDLC (synchronous data link control) are both special features for System/32. When either is installed with the appropriate system control programming, the feature enables System/32 to become part of a telecommunications network.

As part of a telecommunications network, System/32 can transmit and receive information over telecommunications lines connected with devices and systems at other locations, such as with an IBM 3741 Data Station at another location or with a central system at a home office. System/32 transmits and receives information over a telecommunications line much as system operators might exchange information over a telephone line.

The BSCA and SDLC features can be installed on any model of System/32. However, both cannot be installed on the same system. Your IBM representative can help you decide which feature best suits your requirements.

| The IBM 3741 Data Station and IBM 3741 Programmable Work Station are
single-operator key entry stations that record data on diskettes. An IBM 3741
uses the same diskettes as System/32. Though not itself part of System/32, an IBM
3741 can significantly increase the productivity of a System/32 installation—an IBM
3741 can be used to record input for System/32 at the same time System/32 is
processing other data.

Display Screen Keyboard Diskette Drives
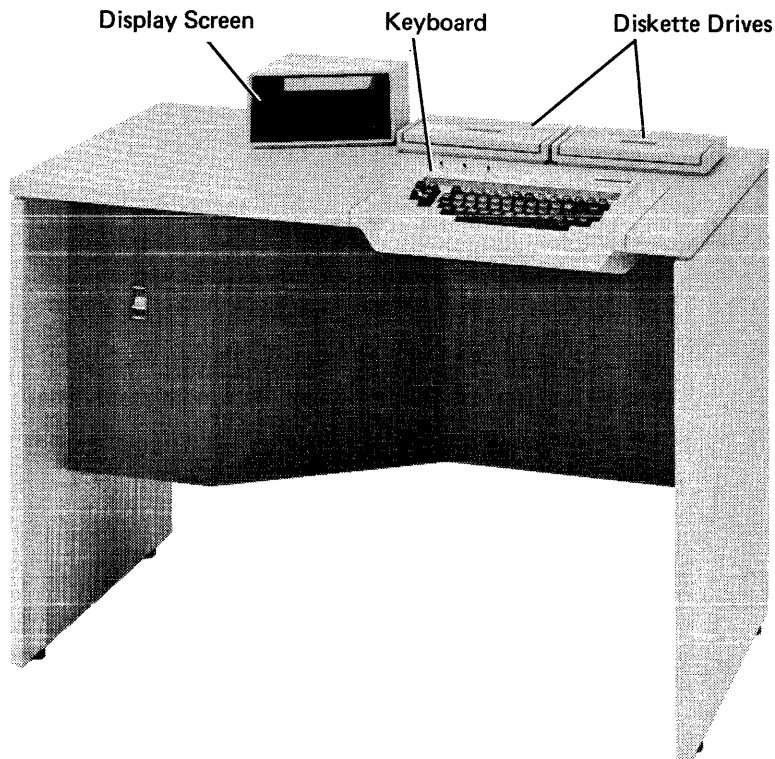
IBM 3741

From the operator's point of view, an IBM 3741 is much like System/32. The
keyboard on the IBM 3741 is similar to the System/32 keyboard; an IBM 3741
diskette drive is similar to the System/32 diskette drive; and the IBM 3741 has
a display screen that, like the display screen on System/32, displays data as it
is keyed so the operator can verify data before it is passed to System/32 for
processing.

For a more detailed description of the IBM 3741 stations and other devices
in the IBM 3740 Data Entry System, see *IBM 3740 Data Entry System System
Summary and Installation Planning,* GA21-9152.

MODEL SUMMARY

The models of IBM System/32 differ in printing speeds and disk storage capacities. The following quick-reference chart isolates each model according to its printing speed and disk capacity. Each model listed is available with a main storage capacity of 16,384 (16K) bytes, 24,576 (24K) bytes, or 32,768 (32K) bytes. For convenience, disk capacities are approximated in the chart in megabytes (one megabyte is one million bytes).

	Printing Speed	Disk Capacity	
		5.0 Megabytes	9.1 Megabytes
Serial Printer	40 chars/sec	Model A12	Model A13
	80 chars/sec	Model A22	Model A23
Line Printer	50 lines/min	Model B12	Model B13
	100 lines/min	Model B22	Model B23
	120 or 155 lines/min	Model B32	Model B33

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Chapter 4. Operating IBM System/32

One duty of every computer operator is to attend to certain physical requirements of the system. The IBM System/32 operator, for example, must see that required diskettes are at hand and must keep paper or forms in the printer.

But the principal duty of every computer operator is to initiate and control the execution—performance—of specific data processing jobs.

OPERATION CONTROL LANGUAGE

Usually a computer operator initiates and controls job execution by means of an operation control language (OCL). This technical language is composed of statements that describe data processing jobs to a system control program. The job description provided in OCL statements enables the system control program to supervise the execution of a job.

Because a system control program, like all computer programs, requires exact instructions before it can perform a job, each job must be described completely and in precise detail. The System/32 system control program must be told, for instance, the name of each file it is to process, where that file is (on a diskette or on the disk), what application program must be used or which system utility program, what kind of output should be provided, what date is to be printed on output reports, and so on. This requirement for precision and comprehensive detail is reflected in the complexity of most operation control languages.

With many computers the burden of this complexity passes directly to those who use the computer, requiring a programmer or technically trained operator at each installation. Because of the flexibility of the System/32 system control program, however, and because of the scope of the System/32 system utilities, the System /32 operator need not attend to the intricacies of OCL. Short, simple statements composed of familiar, nontechnical terms are sufficient for describing a job to System/32. The statements are called command statements.

COMMAND STATEMENTS

Command statements direct the System/32 system control program to procedures.
A System/32 procedure is a collection of OCL statements that describe a specific data
processing job. That job may require an application program or a system utility pro-
gram. If the job requires a system utility, control statements describing the utility are
included in the procedure. So whether the job requires an application program or a
utility, the operator need not enter numerous OCL or utility control statements to
initiate and control the job. The operator has only to enter the command statement
that identifies the related procedure.

REPORT (A Command)

      └─ Points to ─────── REPORT (A Procedure)

                                └─── Initiates ─────── :REPORT:

                                       Creation of
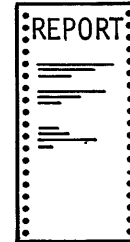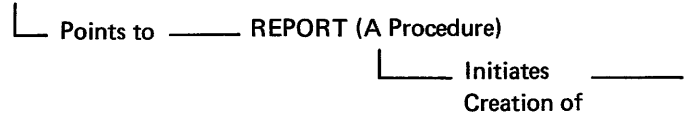
The OCL statements and utility control statements required by the System/32 system
utilities are stored in procedures supplied with the System/32 system control program.
The OCL statements required by application programs can also be stored in pro-
cedures. In other words, the System/32 operator can initiate and control each
System/32 system utility program and each application program simply by entering a
command statement.

ENTERING COMMAND STATEMENTS

Command statements can be entered from the keyboard like data. That is, the
operator uses all the data and special function keys required, and System/32 main-
tains system-to-operator communication on the display screen. If the operator keys
a command statement incorrectly or fails to enter all the information required,
System/32 displays a message identifying the error or requesting the missing informa-
tion.

Suppose a System/32 operator wants to prepare customer invoices from the day's
orders, and wants to save the invoice information to prepare a monthly sales report.
The customer information was recorded earlier on System/32 and stored in a disk data
file named ORDERS. ORDERS was then used as input for an application program
that prepares order forms for the warehouse. ORDERS is still on the disk. Though
the order information it contains was used to prepare order forms, the information
itself is unchanged.

Preparing Invoices

In our example, the application program that prepares invoices from customer orders is named BILLING. The System/32 operator can initiate and control the application by entering a single command statement—all the control information required by the application is provided in a procedure. The command statement that identifies this procedure is

BILLING

To prepare the customer invoices, then, the System/32 operator merely inserts the appropriate forms in the printer, keys

BILLING

on the keyboard, and presses the ENTER key.

Suppose, though, the operator entered BILLINN instead of BILLING. The system control program would display a message to the effect that no such procedure exists. The message would appear on the display screen just below the command statement BILLINN, drawing the operator's attention to the error. The operator could then easily correct the error by keying BILLING and pressing the ENTER key.

Saving Invoice Information

The operator in our example wants to save invoice information on a diskette. From the operating instructions provided with the BILLING application program, the operator knows that the invoice data, which is output from the BILLING application program, is now on the disk, stored in a file named INVOICES.

To save INVOICES on a diskette, the System/32 operator can use the SAVE procedure, a procedure provided with the System/32 system control program. The operator can initiate the procedure by entering the SAVE command statement. As required by the System/32 system control program, the operator includes in the SAVE command statement both the name of the file being saved—INVOICES— and the diskette identification recorded on the diskette to which the file is being copied, thereby ensuring that the proper file is saved on the appropriate diskette. The operator also indicates in the SAVE command statement the length of time the file is to be saved— one month in this example.

At the end of the month, the operator will use the saved data as input for an application program that produces a monthly sales report.

System/32 command statements offer the operator a simple alternative to complex OCL statements. However, System/32 is provided with a complete operation control language. The control language is always available to programmers who want to write their own System/32 application programs and develop specialized procedures.

System/32 OCL statements are entered from the keyboard like data or command statements, and any collection of OCL statements can be stored on the disk as a procedure. Like the procedures supplied with System/32, a procedure developed at a System/32 installation can be assigned a unique name. Whenever a procedure is assigned a name, the operator can identify the procedure, and initiate the re- lated application, by entering a command statement of the same name. Thus, the convenience of command statements can extend to all System/32 application pro- grams.

By accepting either a command statement or numerous OCL statements, the System/32 system control program simplifies operation without restricting the capabilities of the system—or restricting those who want to develop sophisticated programs and procedures for the system.

OPERATING IBM SYSTEM/32—SUMMARY

Command statements are the only operation control statements a System/32 operator needs. Command statements are short, simple, and composed of terms easily associated with specific applications and utilities.

The uniformity and simplicity of command statements, the keyboard function keys, and the quick reference provided on the display screen all make command statements easy to enter and System/32 easy to operate.

Together these operating aids:

- Minimize the training a System/32 operator needs and encourage operator confidence

- Minimize the time needed to accomplish work on System/32

- Minimize the chances for error

However easy a system is to operate, though, the effective operator still must be familiar with the requirements as well as the capabilities of the system. But the System/32 operating aids remove the complexities of system control from the operator's concern—the features enable the operator to devote more attention instead to data entry, data verification, planning, and processing.

Chapter 5. IBM System/32 System Control Programming, Program Products, and Services

A computer data processing system represents an investment in your business. This chapter summarizes the system control program features, program products, and services that help you get the most from an investment in IBM System/32.

IBM SYSTEM/32 SYSTEM CONTROL PROGRAMMING

Complete system control programming is supplied with every System/32. The unique characteristics of this programming account for the system's unique combination of performance and simplicity of operation.

The System/32 system control program provides the same performance expected from the control programs of much larger systems. It coordinates system functions and application programs in order to meet specific data processing requirements with maximum system efficiency. System/32 system control programming also includes a wide variety of system utility programs. The system utilities perform many routine tasks for the operator—tasks like creating backup copies of sensitive data, reorganizing disk storage space for maximum efficiency, and copying data from one diskette to another.

In addition, the System/32 system control program simplifies system operation by:

● Recognizing simple command statements as well as detailed OCL statements

● Interpreting special keyboard function and command keys as well as the familiar alphabetic and numeric keys

● Supporting two forms of magnetic disk storage—the disk and diskettes

● Accepting input entered on the IBM 3740 Data Entry System

● Constantly maintaining communication with the operator by displaying clear and direct messages on the display screen

System/32 system control programming simplifies system operation without denying the professional programmer and highly skilled operator the flexibility expected from larger systems, and without sacrificing capabilities inherent in System/32. In summary, System/32 system control programming helps you secure advanced data processing abilities whether or not you have advanced data processing skills.

PROGRAM PRODUCTS

IBM System/32 Utilities Program Product

The IBM System/32 Utilities program product helps you manage System/32 data files and the System/32 library. The System/32 library is an area on the disk which contains procedures, messages that System/32 displays on the display screen, application programs, and space reserved for use by System/32 system control programming. Information is stored in the library in distinct collections called library members, much as data is stored on the disk in distinct files.

The System/32 Utilities program product is composed of three parts: Data File Utility (DFU), Source Entry Utility (SEU), and Sort.

Data File Utility (DFU)

You can use DFU to create and change data files and library members that contain procedures or source statements. Source statements are statements that, once they are in the library, can be translated by a program product into a computer program.

Information to be entered in a data file or library member is keyed on the keyboard by the operator and arranged in the proper format by the enter function of DFU. Similarly, changes to existing data files or library members are inserted and stored by the update function of DFU.

You can use the inquiry function of DFU to find a particular record in a data file or library member and display the record on the display screen. If you press the DFU command key PRINT REC while the record is being displayed, the inquiry function prints the record. The list function of DFU prints the records in data files and library members in requested report formats.

Source Entry Utility (SEU)

The primary function of SEU is to help the System/32 operator enter procedures and source statements such as RPG II statements into the library. (The RPG II program product is described in this chapter.)

If SEU discovers an error in an RPG II statement when the statement is keyed, a message identifying the error is displayed on the display screen so the operator can correct the statement before it is recorded on the disk.

In the same way that SEU helps the operator enter source statements, SEU helps the operator change source statements that were entered earlier.

Sort

Sort arranges the records in a data file into ascending or descending sequence (whichever is specified) according to data contained in the records. Sort can be used with the list function of DFU to print the records of a file in a particular sequence without disturbing the order in which the records are stored on the disk.

Using the keyboard, the System/32 operator communicates with the Utilities program product in an interactive manner. The operator requests a function by entering the name of the function on the keyboard. The function then prompts the operator for specific information about the job by displaying a message on the display screen. The operator responds by entering the requested information. If the operator keys an invalid response, the function displays a message that describes the error.

(The operator can choose to request the sort function by entering OCL statements and sort sequence specifications instead of requesting the function in the interactive manner just described.)

RPG II Program Product

RPG II is a commercially oriented programming language. It is specifically designed for writing application programs that meet common business data processing requirements. RPG II statements for application programs are written on RPG specification sheets to simplify keying the statements into the system. The RPG II statements keyed from these sheets are translated into a computer program by another computer program called the RPG II compiler. (The operator can use the Source Entry Utility (SEU), which is described under *IBM System/32 Utilities Program Product* in this chapter, to help enter RPG II statements from RPG II specification sheets.)

The RPG II compiler for System/32 enables you to develop your own RPG II application programs for System/32. The compiler is stored on the disk. As it translates, or compiles, RPG II programs, the compiler checks the instructions for errors and prints messages that identify any errors found.

Two functions included in the RPG II program product are auto report and BSC (binary synchronous communications) support. Auto report simplifies the defining of formats for reports printed by RPG II application programs. BSC support provided with RPG II enables you to develop RPG II application programs that use the BSCA (binary synchronous communications adapter). The BSCA is a special feature available for System/32. System/32 application programs that use the BSCA can transmit and recieve data over telecommunications lines connected with other systems or terminals.

INDUSTRY APPLICATION PROGRAMS

System/32 is supported by a number of Industry Application Programs (IAPs). An IAP is an application program designed for a particular industry, such as construction or wholesale food distribution. Each IAP meets a variety of data processing requirements common to businesses operating within the industry.

The range of functions provided in an IAP can be adapted to your company's requirements by means of a questionnaire filled out by you and your IBM representative. Your responses to the questionnaire will portray the data processing requirements of your organization, and will be used to select the IAP functions you need. All documentation necessary to use the functions on your system will be provided with the IAP.

Your IBM representative is ready to help you select, order, and install the IAPs that fit your organization's data processing requirements.

SERVICES

Education

A well-trained, confident operator is essential to the effective use of any computer. Although IBM System/32 requires a minimum of computer knowledge and training, some operator education is required to ensure productive use of the system. IBM offers an operator's training course to thoroughly and carefully train all prospective System/32 operators.

IBM also offers many other System/32 classes, including an introductory course for executives and supervisory personnel, to provide varying degrees of computer expertise. These classes, many of which are self-study courses that you can take at your office at your convenience, range from elementary implementation techniques to advanced programming topics.

The comprehensiveness of the IBM education program helps you develop whatever computer skills you decide your company needs in order to take full advantage of the capabilities of System/32.

Physical Installation

All IBM System/32 models ordered from IBM are installed by an IBM customer engineer. You are responsible for allocating floor space for System/32 and seeing that the required power outlets are available. Your IBM representative will provide you with physical planning information.

GROWTH

The range of services and products available for System/32 lets you fashion a system that meets today's processing requirements and anticipates those of the future. For example, you can select a disk storage capacity and printer speed that not only will accommodate current data files and printing applications, but will also be sufficient for increased volumes of data. Or you can upgrade your disk storage capacity and printing speed as new requirements arise.

Diskette interchangeability allows you to increase your data entry capability by using an IBM 3741 Data Station or IBM 3741 Programmable Work Station to record input for System/32. You can also install telecommunications support to exchange data with remote systems and terminals. And, of course, you can always use additional application programs as you identify additional data processing requirements.

Your IBM representative is ready to help you plan and develop a System/32 data processing system that not only suits your immediate needs, but will also grow with your business.

access time: The time required to find a specified disk area of 256 bytes.

application program: A program that specifies distinct operations to be performed on specific input to obtain unique output. Application programs operate directly on data to meet specific data processing requirements. Contrast with *system control program.*

auto report: A function included in the RPG II program product that simplifies the defining of formats for reports printed by RPG II application programs.

binary synchronous communications (BSC): A flexible form of line control that provides a set of rules for transferring data over a telecommunications line connecting two devices that use the binary synchronous communications adapter (BSCA) feature.

binary synchronous communications adapter (BSCA) feature: One of the special features available for System/32 that enable System/32 to become part of a telecommunications network. (The synchronous data link control (SDLC) feature also enables System/32 to become part of a telecommunications network.)

BSC: See *binary synchronous communications.*

BSCA feature: See *binary synchronous communications adapter feature.*

byte: The magnetic disk storage or main storage space for one character of information. See also *magnetic disk storage* and *main storage.*

character set: The set of characters printed by a printer.

command keys: Special keys on the System/32 keyboard used to request system functions and processing applications. The particular function associated with a command key can be assigned by the application programs used on the system. Contrast with *function keys.*

command statement: A statement used to request the performance of a particular function on System/32. Command statements contain familiar, everyday terms that let the operator avoid the highly technical control language normally required by a computer system.

compiler: A program that translates a series of instructions written in a programming language into a computer program.

control statement: A statement that gives the system control program or a system utility program information about how to perform a requested function. See also *OCL, system control program,* and *system utility programs.*

data processing: Performing a series of planned actions upon information to achieve a desired result.

DFU (data file utility): Part of the IBM System/32 Utilities program product, used to create and change data files and certain kinds of library members.

disk: A thin, circular plate coated with magnetic material on which data is recorded as magnetic spots. The System/32 disk is an integral part of the system, used primarily for storage of frequently run programs and large volumes of frequently used data.

disk data file: A group of related records (data) stored on a magnetic disk.

disk drive: The mechanism used to read from and write on the disk.

disk storage: The use of magnetic disks for storing information.

disk track: One of a series of concentric circles on the surface of a magnetic disk. When information is stored on a magnetic disk, it is stored on the tracks on the disk.

diskette: A small, flexible magnetic disk permanently enclosed in a protective jacket. Diskettes are removeable and are used to store information until it is required for processing. See also *diskette interchangeability.*

diskette drive: The mechanism used to read from and write on a diskette.

diskette interchangeability: The characteristic of diskettes that permits a diskette to be read by a system other than the system used to record information on the diskette.

display screen: A device similar to a small television screen used by System/32 to display information to the operator.

function keys: Special keys on the System/32 keyboard used to request specific system functions. Though one function key may be used in different ways by the system or IBM program products, the functions of the keys cannot be assigned by application programs. Contrast with *command keys.*

IAP: See *Industry Application Program.*

IBM 3741: A data entry device for recording information on diskettes. An IBM 3741 has a keyboard, a display screen, and diskette drives.

Industry Application Program (IAP): A System/32 application program designed by IBM to meet selected data processing requirements in a particular industry. The range of functions provided in an IAP can be adapted to the requirements of individual System/32 installations within the associated industry.

input: Data that is to be operated on (processed) by the computer.

input/output overlap: The performance by a system of selected input and output operations simultaneously with processing operations.

keyboard: A set of keys, similar to typewriter keys, used by the operator to enter data and control information into System/32.

keylock feature: A key-operated power switch for System/32, used to help prevent unauthorized system operation.

library: An area on the disk containing procedures, messages that can appear on the display screen, application programs, and space reserved for system control programming.

library member: A named collection of information stored in the library (analogous to a *file* of data).

line printer: A printer which prints characters from an embossed print belt. Contrast with *serial printer.*

magnetic disk: Same as *disk.*

magnetic disk storage: Same as *disk storage.*

main storage: The general purpose storage (work area) of the processing unit. Main storage holds program instructions for a job and data to be processed during that job.

OCL (operator control language): The control language used to communicate with the system control program. OCL is composed of statements by which specific system functions are requested.

operator panel: The rectangular panel to the right of the keyboard containing the system power on/off switch and other system control keys and indicator lights.

output: The result of processing input. See also *data processing* and *input.*

print belt: A belt on which a character set for the line printer is represented. Print belts for the line printer are interchangeable.

procedure: A named collection of OCL statements and, possibly, utility control statements that describes a specific data processing job.

processing: The handling of input according to specific instructions or rules; performing a series of planned actions upon information (data) to achieve a desired result.

processing unit: The control center of System/32. It monitors the flow of information into the system, performs calculations and other operations on data, and regulates the flow of output.

program: A sequence of precise instructions to a computer written in a special form the computer can interpret. A program tells a computer where to get input, how to process it, and where to put the results.

read/write head: A device used to record (write) and sense (read) information on the magnetic surface of the disk or a diskette.

RPG II: A commercially oriented programming language specifically designed for writing application programs that meet common business data processing requirements.

SDLC: See *synchronous data link control.*

SDLC feature: See *synchronous data link control feature.*

serial printer: A printer that forms characters from dot patterns. Contrast with *line printer.*

SEU (source entry utility): Part of the IBM System/32 Utilities program product, used by the operator to enter procedures and programs into the library.

Sort: Part of the IBM System/32 Utilities program product, used to arrange records in ascending or descending sequence according to their data content.

source statements: Statements such as RPG II statements that can be translated by a program product into a computer program.

standard interchange format: A physical format for diskettes. Diskettes in the standard interchange format can be exchanged between System/32 and other systems. See also *512-byte extended format.*

synchronous data link control (SDLC): A discipline that manages data transfer over a telecommunications line connecting two devices that use the synchronous data link control feature.

synchronous data link control (SDLC) feature: One of the special features available for System/32 that enable System/32 to become part of a telecommunications network. (The binary synchronous communications adapter (BSCA) feature also enables System/32 to become part of a telecommunications network.)

system control program: A program that controls the movement of data through a computer system as the system carries out the instructions specified in an application program. Contrast with *application program.*

system message: A brief message on the display screen, used to guide the operator through applications, to request specific information needed to complete a job, or to help the operator identify keying errors detected by the system.

system utility programs: A set of programs provided with System/32 that are used to perform the everyday, routine tasks required by any data processing system.

telecommunications line: A telephone line or other communications line that is used in transmitting messages from one location to another.

telecommunications network: A group of two or more devices connected by telecommunications lines over which data is transmitted by one or more of the devices to the other device(s) in the group.

track: Same as *disk track.*

utility control statement: A statement that gives a system utility program information about how to perform a requested function of the utility.

512-byte extended format: A physical format for diskettes. The 512-byte extended format can contain more data than the standard interchange format. See *standard interchange format.*

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