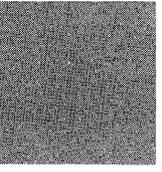
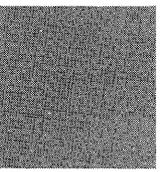
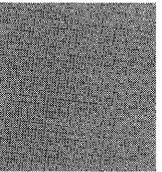
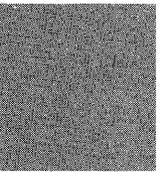
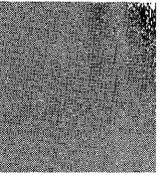
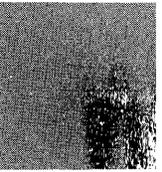
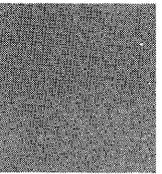
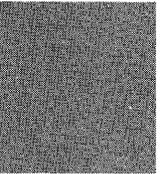
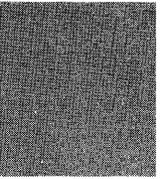


The IBM logo, consisting of the letters "IBM" in a bold, sans-serif font, is positioned inside a dark, textured square.

Systems Reference Library

IBM 1130 System Summary



Tenth Edition (December 1971)

This is a major revision of, and obsoletes, GA26-5917-8 and Technical Newsletters GN34-0034 and GN34-0058. Material relating to the IBM 1131 Models 1C, 1D, 5B, 5C, and 5D, and the IBM 2311 Disk Storage Drive Models 11 and 12 has been added. Technical changes to the text and illustrations are indicated by a vertical line to the left of the change.

Changes are periodically made to the information herein; before using this publication in connection with the installation or operation of IBM systems, refer to the latest 1130 system SRL Newsletter, GN20-1130, for the editions that are applicable and current.

The illustrations in this manual have a code number in the lower corner. This is a publishing control number and is not related to the subject matter. IBM System/7 units shown herein are at development level and may be subsequently modified in appearance.

Copies of this and other IBM publications can be obtained through IBM Branch Offices.

A form for readers' comments is provided at the back of this publication. If the form has been removed, send your comments to IBM Corporation, General Systems Division, Systems Publications, Department 707, Boca Raton, Florida 33432. Comments become the property of IBM.

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Preface

This reference publication describes the machines, features, and programs of the IBM 1130 Computing System. Only basic summary descriptions are in this manual; more extensive descriptions are in other Systems Reference Library publications, which are listed in order number sequence and abstracted in the *IBM 1130 Bibliography*, GA26-5916.

This system summary assumes that the reader has at least a basic background in data processing. No attempt is made in this manual to introduce the reader to basic concepts related to the machines or programs used in any data processing system.

This publication is intended for operating management of data processing systems, marketing representatives, customer and systems engineers, systems programmers and analysts, and instructors.

Note. The IBM 1131 Models 4A and 4B, and the IBM 1132 Model 2, are available in the United States and Canada only.

The IBM 1130 Computing System provides the capacity and versatility to accomplish commercial, engineering, and scientific computations that formerly were possible only with large computer systems. The 1130 fulfills the "general purpose" requirements of these areas with computing power well above previous systems in the same cost range. The 1130 is particularly suited for operation by the individual requiring the problem solution.

The design of the 1130 system is oriented to the operator. Only a minimum of training and experience with computing systems is necessary to make the 1130 usable for solving problems. In addition, IBM relieves the user of detailed programming and provides for the statement of problems in familiar language.

The compact, easily operated 1130 system features the IBM 1131 Central Processing Unit (CPU) with core storage capacity ranging from 4,096 to 32,768 sixteen-bit words. The core storage cycle time is 2.2 or 3.6 microseconds to access a full word of storage. (Each 16-bit word is equivalent to two 8-bit bytes. The term byte is not normally used in reference to 1130 data handling because data is accessed on a 16-bit word basis in the 1130.)

The single disk storage feature of the 1131 models 2, 3, or 4 offers an additional 512,000 words of online storage in a removable disk cartridge. The 1130 system also allows the use of either the IBM 2310 Disk Storage Model B1 or B2, or the IBM 2311 Disk Storage Drive Model 11 or 12. The 2310 model B1 contains a single disk storage drive with a storage capacity of 512,000 sixteen-bit words; the 2310 model B2 contains two disk storage drives in a single stand-alone unit with a total storage capacity of 1,024,000 sixteen-bit words. The 2311 model 11 has a storage capacity of 2,560,000 words, and the 2311 model 12 has a storage capacity of 1,536,000 words. Either one or two 2310 Disk Storage units, or one or two 2311 Disk Storage Drives can be attached to the 1130 system.

The disk storage drives in the 1131 CPU, and the 2310 Disk Storage units use the interchangeable IBM 2315 Disk Cartridge. The 2311 uses the interchangeable IBM 1316 Disk Pack. This disk interchangeability offers virtually unlimited offline storage capacity.

The basic 1130 system consists of the CPU with its integral console printer and keyboard, and either punched card or paper tape input/output.

The wide range of input/output configurations and storage capacities gives the user the ability to tailor the 1130 system to fit his present needs and to expand the system as his needs increase. The *IBM 1130 Configurator*,

GA26-5915, provides a graphic representation of all possible 1130 system configurations including standard features, special features, and their prerequisites.

The following features are available for the 1130 system:

- Core storage capacities as designated by a letter following the 1131 model number: A=4k, B=8k, C=16k, and D=32k (16-bit words).
- Core storage access cycle time of either 3.6 microseconds (1131 models 1, 2 and 4) or 2.2 microseconds (1131 models 3 and 5). The CPU instruction execution cycle is slower on the 1131 model 4 even though the storage access time is 3.6 microseconds.
- Paper tape input/output with the IBM 1134 Paper Tape Reader Model 1 or 2, and the IBM 1055 Paper Tape Punch Model 1.
- Punched card input/output with the IBM 1442 Card Read Punch Model 6 or 7, or the high-speed IBM 2501 Card Reader Model A1 or A2, and the IBM 1442 Card Punch Model 5.
- Printed output with the IBM 1132 Printer Model 1 or 2, or high-speed printed output with the IBM 1403 Printer Model 6 or 7.
- Document reading with the IBM 1231 Optical Mark Page Reader Model B1.
- On-line, high-speed storage with the single disk storage drive and either the IBM 2310 Disk Storage Model B1 and/or B2; or the 2311 Disk Storage Drive Model 11 and/or 12.
- Graphic display with the IBM 2250 Display Unit Model 4. Copies of displayed images can be obtained through use of the IBM 2285 Display Copier. This device, which is nonprogrammed, attaches directly to the 2250 and provides hard copy of displayed images as requested by the operator.
- Graphic documentation with the IBM 1627 Plotter Model 1 or 2.
- Entry of sensor-based data from the IBM System/7 through the storage access channel.
- Communication with external devices with the storage access channel.
- Communication with remote systems or devices with the synchronous communications adapter.

The following sections of this manual present summary descriptions of the components of the IBM 1130 Computing System and the associated programs and programming systems. The publication *IBM 1130 Bibliography*, GA26-5916, contains a list of publications that present more detailed operating and programming information on each part of the system.

IBM 1131 CENTRAL PROCESSING UNIT

The IBM 1131 Central Processing Unit (Figures 1 and 2) is a compact and versatile component of the 1130 Computing System. The design is oriented to the operator, and a minimum of training and experience with computing systems is sufficient to use the 1131 to solve problems.

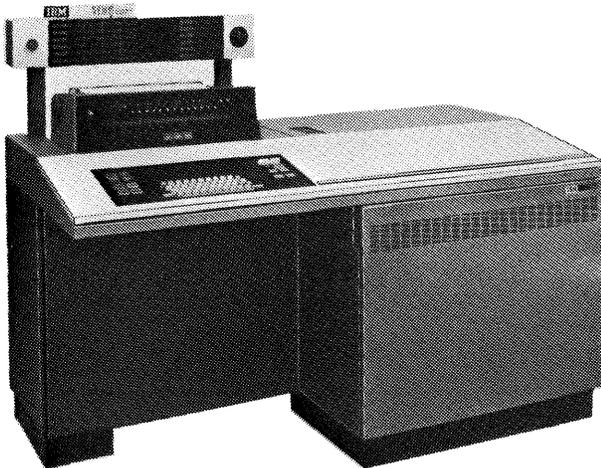
The keyboard/printer console provides control of the operation. The console displays the data in the various registers and counters within the CPU, and switches are used for data entry and program control. The keyboard also permits data entry directly into core storage, and the printer produces printed output of the data in core storage.

The five models of the 1131 and their storage-access cycle times are:

Model	Storage-Access Time (in microseconds)
1	3.6
2	3.6
3	2.2
4	3.6
5	2.2

A single 16-bit word (two bytes) is accessed during each storage-access cycle.

Models 2, 3, and 4 (not model 1 or 5) have a single disk storage drive housed in the CPU.



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Figure 1. IBM 1131 Central Processing Unit (Models 1A, 1B, 2A, 2B, 4A, and 4B)

Single Disk Storage

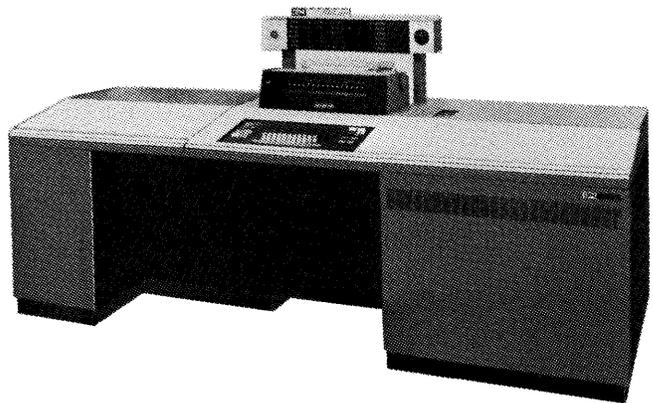
Single disk storage is an auxiliary storage device housed within the 1131 CPU enclosure. It consists of a single disk drive and a removable disk cartridge. Storage capacity of each cartridge is 512,000 sixteen-bit words. The data transfer rate of the disk storage is 720,000 bits per second. The removable IBM 2315 Disk Cartridge permits easy access to data or to entire programs. Additional disk cartridges can be stored offline and put online as needed, thus offering virtually unlimited offline storage capacity.

Core Storage

The 1131 main storage in the CPU uses magnetic cores for data and program instruction storage. Core storage capacity is 4,096 (4k) to 32,768 (32k) sixteen-bit words, depending on the model used.

	A	B	C	D
Model 1	4k	8k	16k	32k
Model 2	4k	8k	16k	32k
Model 3	----	8k	16k	32k
Model 4	4k	8k	-----	-----
Model 5	----	8k	16k	32k

A 16-bit word (equivalent to two 8-bit bytes) can be placed into core storage or retrieved from core storage in one storage cycle, which is 3.6 microseconds for models 1, 2, and 4 or 2.2 microseconds for models 3 and 5.



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Figure 2. IBM 1131 Central Processing Unit (Models 1C, 1D, 2C, 2D, 3B, 3C, 3D, 5B, 5C, and 5D)

The core storage words are individually addressable or may be coupled and operated upon as double (32-bit) words. Data is recorded and processed in fixed-point binary form. The largest positive number is $2^{31} - 1$ (2,147,483,647 in decimal); the largest negative number is -2^{31} (2,147,483,648 in decimal).

Instructions

The 1131 instruction set consists of 29 discrete instructions. A single word or double word instruction format is used to give the CPU added flexibility. Instructions fall into five categories: load and store, arithmetic and logic, shift, branch, and input/output. The 1131 model 4 executes these instructions slower than the other models. Three index registers and indirect addressing facilities are available for programming use.

Storage Access Channel

The storage access channel (SAC) provides a means for external devices or systems to communicate directly with the 1131 CPU core storage. Communication with core storage from an external device is on either a cycle-steal or an interrupt basis, and is initiated by the external device when it is ready to communicate. The IBM 1133 Multiplex Control Enclosure attaches to the SAC and provides the optional storage access channel II, thus giving a similar facility to systems which have the 1133 attached.

Interrupt

The interrupt operation of the 1130 system allows each input/output device to operate at a maximum speed consistent with the programmed operation and makes the CPU available except during the actual transmission of data.

To request service, a device signals the CPU on one or more of the six interrupt levels. Each level has an established priority. If a higher priority device is not being serviced, the device requesting service will interrupt the program long enough to execute the requested service.

The number of interrupt levels normally used depends upon the input/output configuration of the system.

Cycle Steal

High-speed data channels that transmit data to and from the CPU on a cycle-steal basis are used to operate the 2501 Card Reader, 1403 Printer, 1132 Printer, 2250 Display Unit, and all disk storage drives.

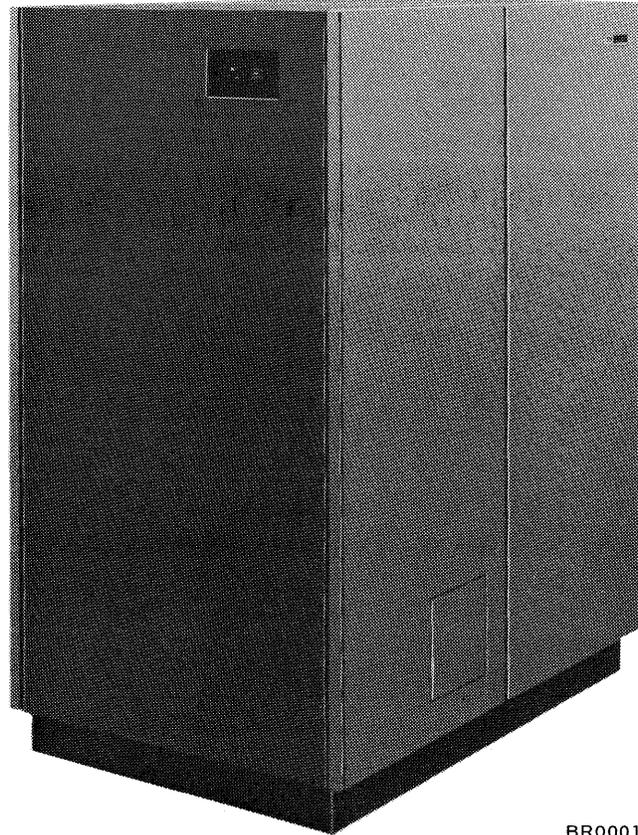
Cycle stealing should not be confused with interrupt. A device using the cycle-steal method does not interrupt the program to transfer data; it steals one cycle from the instruction being executed and transfers a character directly into or out of core storage without control of the CPU.

This type of operation requires less CPU time than would otherwise be required to service the above devices.

IBM 1133 MULTIPLEX CONTROL ENCLOSURE

The 1133 Multiplex Control Enclosure (Figure 3) provides a communication path between external units or systems and the 1131 CPU. Units of the 1130 system that require the 1133 are:

- IBM 1403 Printer Model 6 or Model 7
- IBM 2310 Disk Storage Model B1 or Model B2
- IBM 2311 Disk Storage Drive Model 11 or Model 12



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Figure 3. IBM 1133 Multiplex Control Enclosure

IBM 1442 CARD READ PUNCH

The IBM 1442 Card Read Punch Model 6 and Model 7 (Figure 4), provides serial reading and punching of cards for the 1130 system.

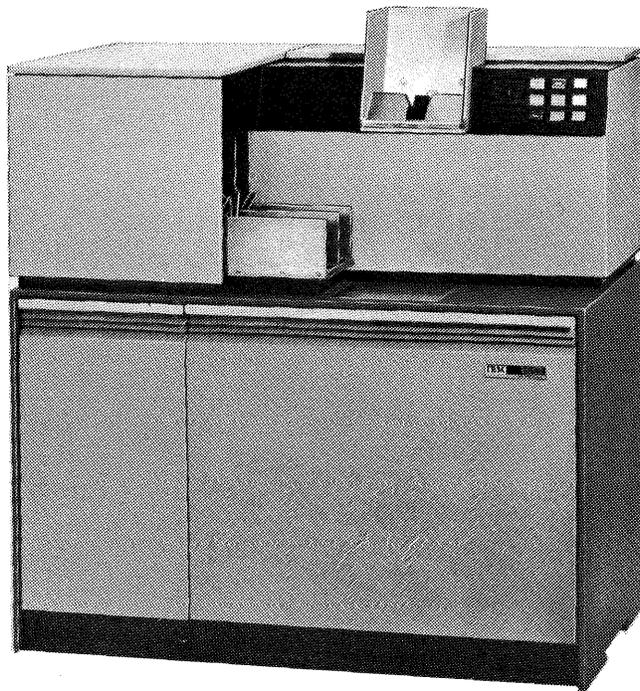
The rated speeds of the two models attached to the 1130 system are:

Model 6

Read—300 cards per minute
Punch—80 columns per second

Model 7

Read—400 cards per minute
Punch—160 columns per second



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Figure 4. IBM 1442 Card Read Punch

IBM 1442 CARD PUNCH

The IBM 1442 Card Punch Model 5, provides serial punching of cards at 160 columns per second for the 1130 system. The model 5 may be attached to an 1130 system (with the exception of the 1131 model 4) in place of a 1442 model 6 or model 7.

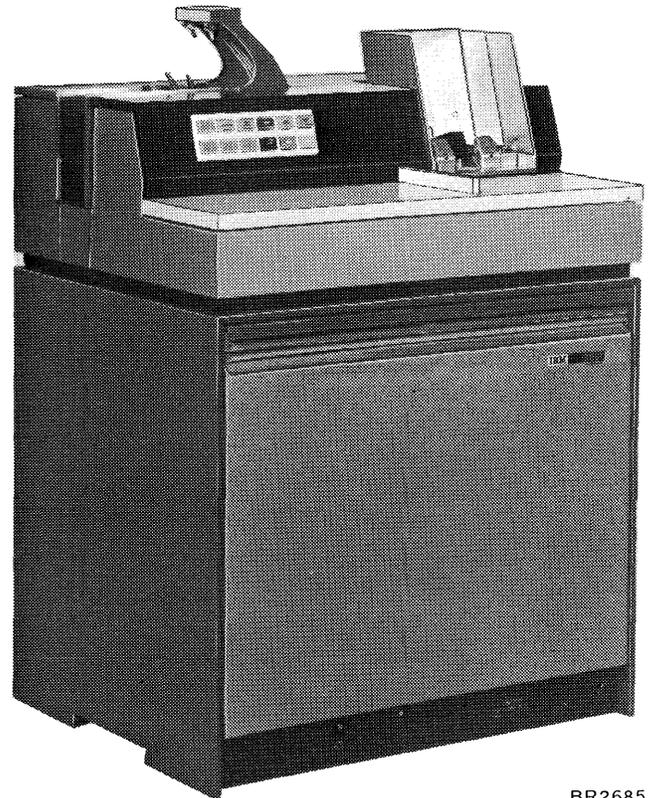
The 1442 Card Punch Model 5, and the 2501 Card Reader have separate card paths for the overlap of card reading and punching.

IBM 2501 CARD READER

The IBM 2501 Card Reader (Figure 5) provides the 1130 system with high-speed card input.

The 2501 model A1 reads punched cards at a maximum rate of 600 cards per minute (cpm); the model A2 reads at a maximum rate of 1,000 cpm.

The 1442 Card Punch Model 5, is the companion unit to the 2501 Card Reader. However, the 1442 model 6 or 7 may be attached in place of the model 5. In such a configuration the 2501 is considered the primary card input unit.



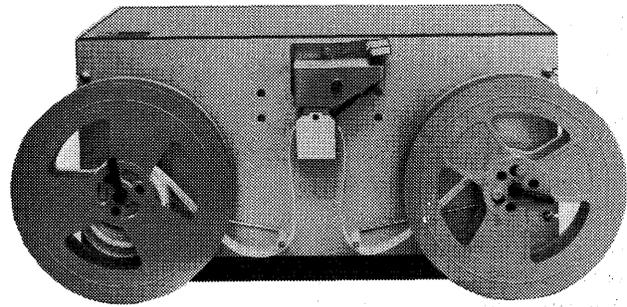
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Figure 5. IBM 2501 Card Reader

IBM 1134 PAPER TAPE READER

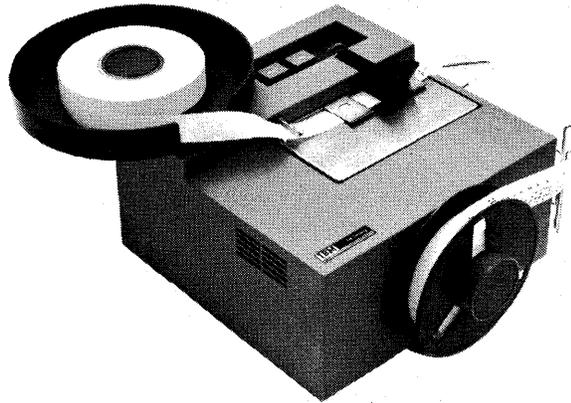
The IBM 1134 Paper Tape Reader (Figure 6) is a compact, self-contained device capable of reading eight-channel perforated tape at speeds up to 60 characters per second. Either paper or polyester tape can be used. (Refer to the *IBM 1130 Functional Characteristics*, GA26-5881, for tape specifications.) The model 1 reads strips of punched tape only; the model 2 has supply and takeup reels for reading punched tape fed in strips or from reels. The 1134 dynamically senses the presence of holes in the tape, thus ensuring positive identification of characters. Tape motion and tape reading are controlled by the operating program.

Each punched character is read into one addressed core storage location. Translation of the character code placed in core storage is accomplished through programming.



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Figure 6. IBM 1134 Paper Tape Reader



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Figure 7. IBM 1055 Paper Tape Punch

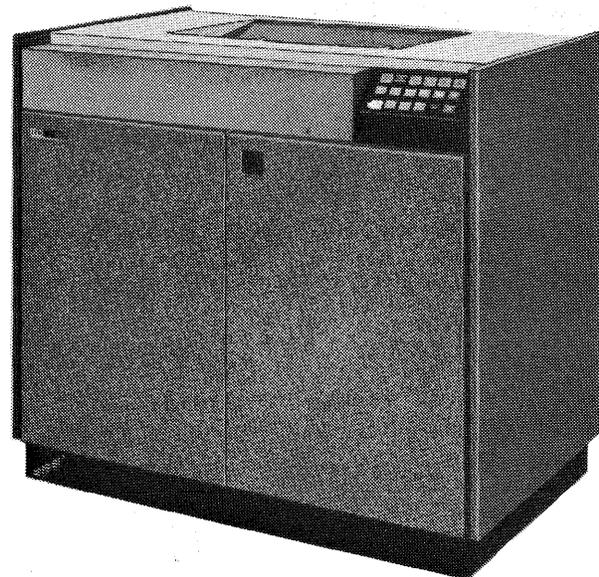
IBM 1055 PAPER TAPE PUNCH

The 1055 Paper Tape Punch (Figure 7) punches one-inch, eight-channel paper tape at the rate of 14.8 characters per second. Data is punched as an image of the data in core storage on a character-by-character basis.

IBM 1132 PRINTER

The 1132 Printer (Figure 8) operates as an on-line output unit. The printer is equipped with a tape-controlled carriage for transporting continuous paper forms. Alphameric data is printed on the model 1 at the rate of 80 lines per minute, whereas consecutive all-numeric lines of data are printed at the rate of 110 lines per minute. The model 2 prints alphameric data at the rate of 40 lines per minute and consecutive all-numeric lines of data are printed at the rate of 55 lines per minute. The print line is 120 characters in length. All printing and carriage operations are under control of the central processing unit program.

At each of the 120 print positions is a printwheel that contains 48 alphabetic, numeric, and special characters. Alternate typewheel arrangements are available.



BR2688

Figure 8. IBM 1132 Printer

IBM 1403 PRINTER

The 1403 Printer (Figure 9) offers high-speed, on-line printing capabilities for the 1130 Computing System. Two models are available for attachment to the 1130 system through the facilities of the 1133.

The IBM 1403 Printer Model 6 has 120 print positions and prints at a maximum rated speed of 340 or 210 lines per minute (lpm), depending upon which attachment feature, in the 1133 Multiplex Control Enclosure, is specified. The type HN chain is standard and has a 48-character printing set.

The IBM 1403 Printer Model 7 is identical to the model 6 with the exception of speed. The model 7 has a maximum rated speed of 600 lines per minute.

A special feature, the interchangeable chain cartridge adapter, number 4740, is available for either the model 6 or model 7.

IBM 2310 DISK STORAGE

The IBM 2310 Disk Storage Model B1 or Model B2 (Figure 10) provides the 1130 system with random-access storage up to a maximum of 2,048,000 sixteen-bit words (the equivalent of 4,096,000 eight-bit bytes) on line in addition to the single disk storage drive in the CPU. One or two

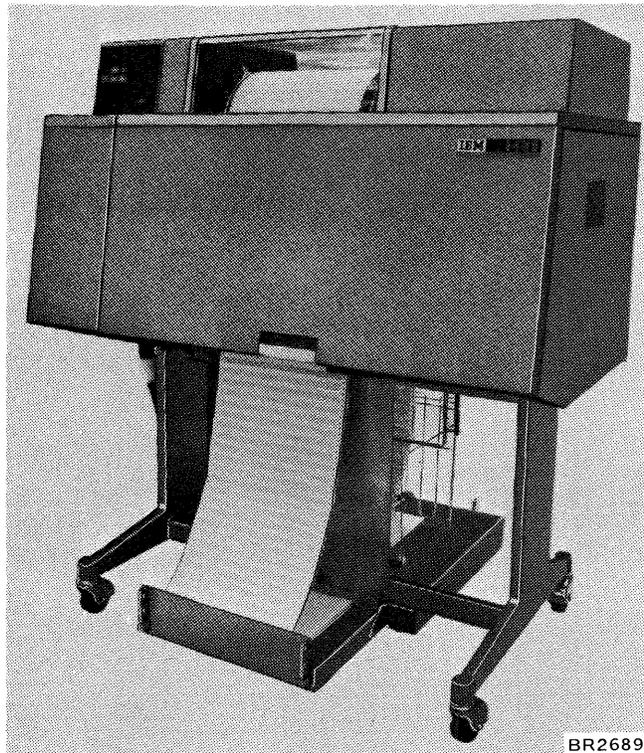


Figure 9. IBM 1403 Printer

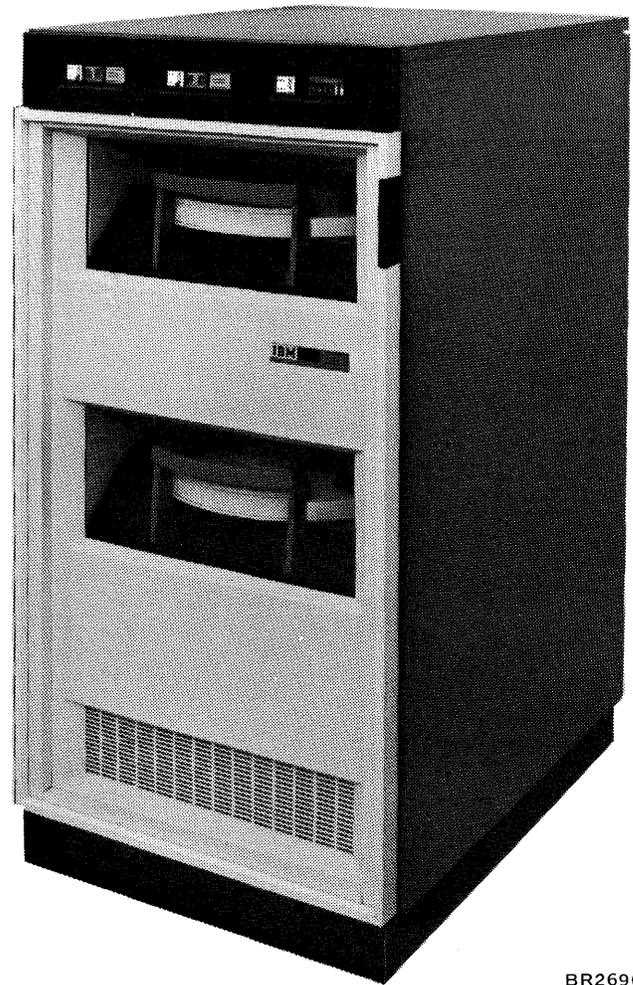


Figure 10. IBM 2310 Disk Storage

2310s (containing up to two disk storage drives each) can be attached to the 1130 system through the channel multiplexer in the 1133. The 2310 model B1 contains a single disk storage drive. The 2310 model B2 contains two disk storage drives.

The disk storage recording medium is an oxide-coated disk in an interchangeable 2315 Disk Cartridge.

The 2310 Disk Storage is divided into 200 cylinders of two tracks each, one track on the upper surface and one track on the lower surface. Each track is divided into four sectors (321 words each; programming systems normally use the first word for sector address) for ease of block handling. The disk cartridge has a capacity of 512,000 sixteen-bit words (based on 320-word sectors), which is equivalent to 1,024,000 eight-bit bytes. The data transfer rate is 720,000 bits per second, which is 36,000 words (equivalent to 72,000 bytes) per second.

The access time for the 2310 access mechanism to move from one cylinder to the adjacent cylinder or two adjacent cylinders is 15 milliseconds (ms) plus an additional delay of about 22.5 ms required for carriage stabilization. A movement of 20 cylinders, therefore, requires 150 ms plus the 22.5 ms delay for carriage stabilization. The average rotational delay, before reading or writing begins, is 20 ms since the disk revolves once every 40 ms.

IBM 2311 DISK STORAGE DRIVE

The IBM 2311 Disk Storage Drive (Figure 11), gives the 1130 system up to 5,120,000 sixteen-bit words of additional online random-access storage (the equivalent of 10,240,000 eight-bit bytes) in addition to the single disk storage drive in the 1131 CPU. Either one or two 2311 Disk Storage Drives, Model 11 or Model 12, in any combination, can be attached to the 1130 system through the channel multiplexer in the 1133. The 2311 model 11 has a storage capacity of 2,560,000 sixteen-bit words; the 2311 model 12 has a storage capacity of 1,536,000 sixteen-bit words. Both models of the 2311 use the IBM 1316 Disk Pack as their storage element.

The 2311 disk storage is divided into 200 cylinders. Each cylinder contains ten recording surfaces on the model 11, and six recording surfaces on the model 12. The recording surfaces are divided into four sectors with 321 words in each sector. This format is the same as that of 2310 Disk Storage.

The 2311 access mechanism has a minimum access time between cylinders of 25 milliseconds, an average access time of 75 milliseconds, and a maximum access time of 135 milliseconds. The average rotational delay, before reading or writing begins, is 12.5 milliseconds since the disk revolves once every 25 milliseconds.

IBM 2250 DISPLAY UNIT

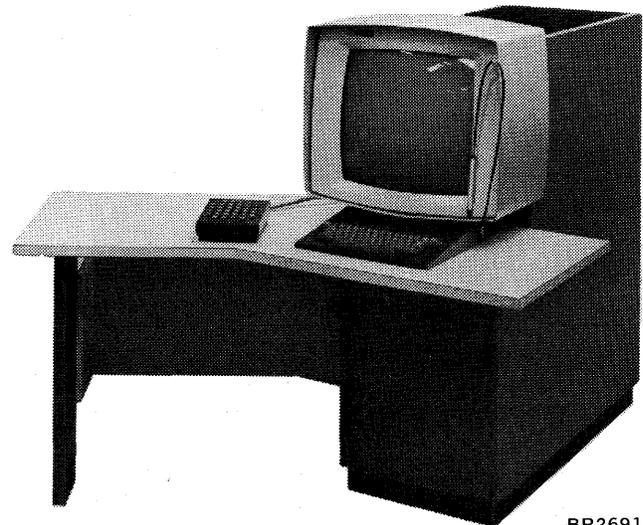
The IBM 2250 Display Unit Model 4 (Figure 12) is a cathode-ray tube display unit that operates asynchronously with the 1130 system. The 2250 operates under the control of a display order program and control commands sent from the 1131 CPU via the storage access channel (SAC or SAC II). The minimum system configuration for attachment of the 2250 is an 1131 model 2B, 2C, 2D, 3B, 3C, or 3D plus a card reader.

The 2250 is a sit-down display console for a single user. In addition to displaying graphic and alphanumeric information, the 2250 offers man-machine interaction through a fiber-optic light pen and two keyboards. Using these facilities, a programmer can furnish computer-aided design capabilities whereby the 2250 user can create, modify, and add graphic and alphanumeric data into the system through the display screen.



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Figure 11. IBM 2311 Disk Storage Drive



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Figure 12. IBM 2250 Display Unit

The fiber-optic light pen, together with the logical capabilities of the 2250, enable the user to identify elements of displayed data to either the display program or the CPU program. Light-pen operations are enabled and controlled by the display program. The user can identify an element simply by pointing the light pen at the element or by pressing the tip switch against the displayed element. The method of identification is determined by the display program.

The two keyboards available as special features for the 2250 are the alphameric keyboard (for message entry and editing) and the programmed function keyboard (for application flexibility). With the typewriter-like alphameric keyboard, the user can enter alphameric messages consisting of letters, numbers, and/or special symbols into the display program for display and editing. The programmed function keyboard provides communication between the user and a CPU program.

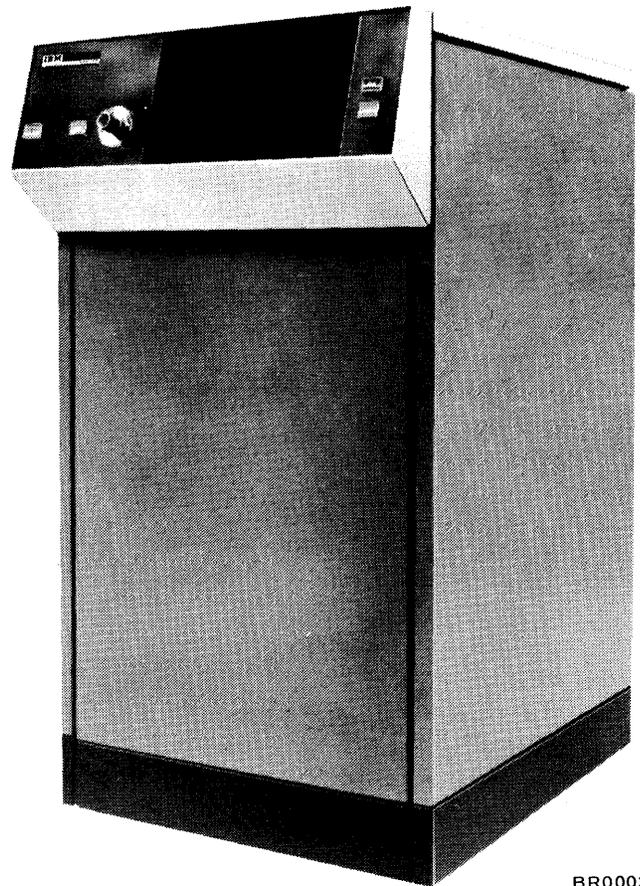
The display area on the screen is 12 inches by 12 inches and is divided into a 1,024X by 1,024Y position grid. Points can be plotted at any intersection on this grid, and straight line segments can be drawn between any two intersections.

Character generation is programmable, providing complete flexibility in the generation and use of character sets. The capability to subscript and superscript characters is also provided.

The display program orders can be sent to the 2250 at a rate up to 40 frames per second; however, the 2250 operation can be delayed while other devices on the system are being serviced. Once 2250 operations have been started, the 2250 addresses CPU storage as required to execute the display program, stealing core storage cycles from the CPU without CPU intervention.

IBM 2285 DISPLAY COPIER

The 2285 Display Copier (Figure 13) attaches directly to any 2250 Display Unit Model 4 that is equipped with the display copier attachment feature. The 2285 provides an 8-1/2-by-11-inch paper copy output of the associated 2250 display upon initiation by the 2250 operator. The 2285 obtains analog signals and power from the 2250 to which it is attached and requires no programming.



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Figure 13. IBM 2285 Display Copier

IBM 1627 PLOTTER

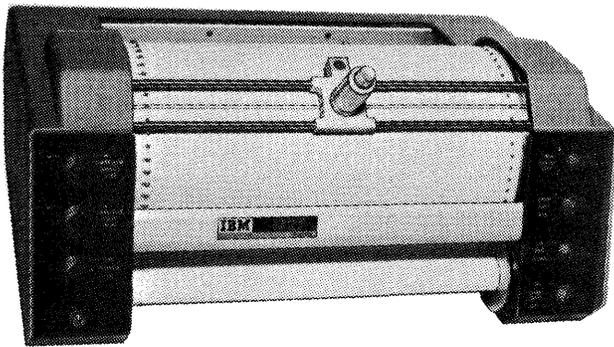
The 1627 (Figure 14) is an incremental plotter that provides the user with a means of converting tabulated digital information into graphic form. Two models are available for attachment to the 1130 system:

Model 1

Plotting area—11 inches by 120 feet
Increment—1/100 inch steps at 300 steps per second

Model 2

Plotting area—29-1/2 inches by 120 feet
Increment—1/100 inch steps at 200 steps per second



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Figure 14. IBM 1627 Plotter



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Figure 15. IBM 1231 Optical Mark Page Reader

IBM 1231 OPTICAL MARK PAGE READER

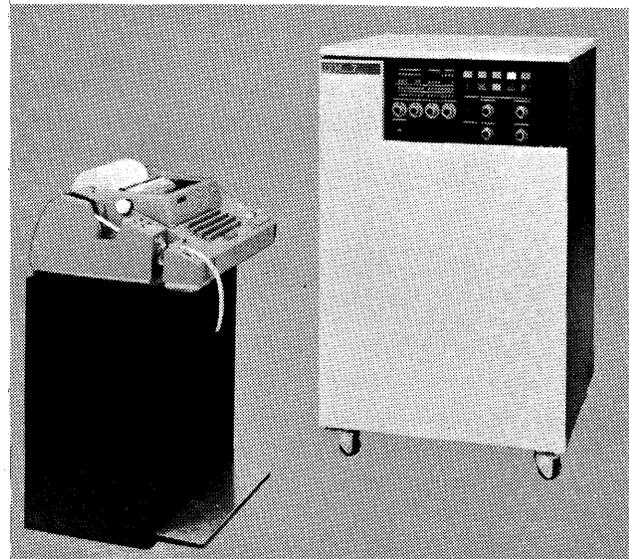
The 1231 Optical Mark Page Reader Model 1 (Figure 15) offers the 1130 system a low-cost mark reading capability.

The 1231 reads positional marks made by an ordinary lead pencil on an 8-1/2 by 11 inch paper document. Collection of these marks is controlled by the 1231, and the marks are available to the 1130 as one segment or two segments depending upon the programmed delay line storage in the Optical Mark Page Reader.

The 1231 has a rated speed of 2,000 documents per hour.

IBM SYSTEM/7

The IBM System/7 (Figure 16) provides the 1130 system with a facility for collecting sensor-based data, causing the performance of some control action, and receiving reports of the progress or results of such collection or control activities. Communication between the 1130 and the System/7 is through the storage access channel in the form of direct storage-to-storage data transfers. The interrupt system allows either system to signal the other that a data transfer is required or has been completed.



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Figure 16. IBM System/7

The System/7 collects input data and transmits output data in either analog or digital form. Typical analog inputs are voltages proportional to process parameters. The sensor-based system has the ability to detect significant changes in these voltages by reading the voltages and converting them to digital values. Similarly, a digital value can be transmitted from the processor module to an analog output unit, converted to an equivalent voltage and sent out to the process.

Typical digital input information consists of the sensing of the opening or closing of an electrical contact or of digital representation of numeric data. Digital output typically consists of the opening or closing of a contact or the turning on or turning off of an electrical current.

Digital information can also be entered into System/7 manually through several types of manual entry units. These manual entry units are available attached to a 2790 Control feature. This feature provides a single loop of 2790 area stations and data entry units.

SYNCHRONOUS COMMUNICATIONS ADAPTER

The synchronous communications adapter special feature enables the IBM 1130 Computing System to function as a point-to-point data transmission terminal, using either private or commercial common carrier (switched or non-switched) line transmission facilities. The adapter sends to or receives data from the line transmission facilities under control of the stored program in the 1130. It operates on an interrupt-request basis similar to that used by other input/output devices in the 1130 system.

The synchronous communications adapter (SCA) provides data interchange between remote locations and a central data processing location. Operation can be in binary-synchronous-communication (BSC) or synchronous-transmit-receive (STR) mode. This adapter permits the 1130 to function as a remote processor terminal communicating with the following terminals or systems:

- IBM System/360 Models 25, 30, 40, 50, 65, 67 (in Model 65 mode), 75, 85, or 195 by means of an IBM 2701 Data Adapter Unit or an IBM 2703 Transmission Control in BSC mode
- IBM System/360 Models 25, 30, 40, 50, 65, 67, 75, 85, or 195 by means of an IBM 2701 Data Adapter in STR mode
- IBM System/360 Model 20 by means of its Communications Adapter in BSC or STR mode
- Another IBM 1130 Computing System by means of the system's synchronous communications adapter in BSC or STR mode
- IBM System/360 Model 25 by means of its integrated communications attachment in BSC mode

- IBM 1009 Data Transmission Unit in STR mode
- IBM 1013 Card Transmission Terminal in STR mode
- IBM 2770 Data Communications System in BSC mode
- IBM 2780 Data Transmission Terminal in BSC mode
- IBM 1800 System by means of its communication adapter in BSC mode
- IBM 7702 Magnetic Tape Transmission Terminal in STR mode
- IBM 7711 Data Communication Unit in STR mode

All character coding is controlled by the stored program and is based on a character length of eight bits. Therefore, any character set which is recognized by both the transmitting terminal and the receiving terminal can be used.

The SCA operates in half-duplex mode using either two-wire or four-wire line transmission facilities. Data rates, selected by the operator, are 600, 1200, 2000, or 2400 baud (bits per second) in STR mode. In BSC mode, the rates are 600, 1200, 2000, 2400, or 4800 baud (bits per second).

The "auto-answer" allows the programmer to control the answering of incoming calls. When the programmer desires to allow the answering of incoming calls, he issues an enable command. He may also disable the auto-answer by issuing a disable command.

The SCA audible alarm may be programmed to turn on to alert the operator. It may be turned off either by programming or by the operator.

IBM offers 1130 system users a powerful set of programs and programming systems specifically designed to relieve the user of much detailed programming effort. Two programming systems are available for the 1130 system:

- IBM 1130 Card/Paper Tape Programming System
- IBM 1130 Disk Monitor System, Version 2

This section presents a brief description of each programming system and its component programs.

Publications supplying detailed information about each program are listed in the Systems Reference Library publication *IBM 1130 Bibliography*, GA26-5916.

IBM 1130 CARD/PAPER TAPE PROGRAMMING SYSTEM

This programming system is designed especially for use on an 1130 Computing System without disk storage. (However, the single disk in the 1131 CPU is supported by the subroutine library.) The following system units are supported by the IBM 1130 Card/Paper Tape Programming System.

- IBM 1131 CPU, Model 1A, 1B, 2A, or 2B
- IBM 1442 Card Read Punch, Model 6 or 7
- IBM 1134 Paper Tape Reader
- IBM 1055 Paper Tape Punch
- IBM 1132 Printer
- IBM 1627 Plotter, Model 1 or 2
- Synchronous Communications Adapter
- Single Disk Storage (in the 1131 CPU)

This programming system comprises four components that are available for either card or paper tape oriented 1130 systems:

- IBM 1130 Assembler
- IBM 1130 FORTRAN Compiler
- IBM 1130 Subroutine Library
- IBM 1130 Utility Routines

Machine Requirements

The minimum machine configuration required for use with the IBM 1130 Card/Paper Tape Programming System includes:

- IBM 1131 Central Processing Unit Model 1A
- IBM 1134 Paper Tape Reader and an IBM 1055 Paper Tape Punch or the IBM 1442 Card Read Punch Model 6 or 7

In addition to the machine units listed above, certain programs require other units. The additional units required are listed with the appropriate program description.

Card/Paper Tape Components

Assembler

The 1130 assembler language permits the programmer to write (code) source programs in a symbolic language that is more meaningful and easier to use than the binary machine language. The symbolic language provides the programmer with mnemonic operation codes, special characters, and other necessary symbols. The use of symbolic labels (names) makes a program independent of actual machine locations. Unique mnemonic operation codes are included to relieve the programmer of coding the machine-language instruction modifications.

Program control instructions are included; these instructions (in conjunction with the program loaders) automatically provide linkage to the IBM-supplied subroutines. The subroutines provided are listed in the subroutine library, which is described later.

The source program, punched in either cards or paper tape, is assembled into machine language by the 1130 assembler. The object program is punched into the first 20 columns of the source card (by the card assembler) during the second pass of the two-pass assembler. This deck is termed the "list deck." The paper tape assembler punches the object program during the second pass of the source program.

Before the object program can be loaded into the CPU for execution, it must be acted upon by the compressor program. This program "compresses" the object information from several list-deck cards into one card. This deck, known as the compressed binary object program deck, can be loaded with the relocatable loader or it can be converted into core-image format by the core-image converter program. The core-image format deck can be loaded by the core-image loader.

Either the relocating loader or the core-image converter program will select (and supply the necessary linkage for) the subroutines used by the object program.

Basic FORTRAN IV

FORTRAN (FORmula TRANslation) is a programming language that allows the engineer and scientist to utilize a computer for problem solving with only a slight knowledge of the computer and a relatively short period of training. FORTRAN is a language that is a compromise between the language of the computer and the language of the scientist and engineer. To satisfy the computer, FORTRAN statements are converted to machine language. To satisfy the engineer and scientist, as many of the detailed computer control operations as possible are eliminated from the job of writing programs, and a statement format close to that of the mathematical equation is used.

The source program, once it is punched into cards or paper tape, is compiled into an object program by the FORTRAN compiler program.

The object program can be loaded to core storage for execution by the relocating loader, or it can be changed to core-image format by the core-image converter program and loaded to core storage by the core-image loader. The relocating loader or the core-image converter program will select and automatically produce the linkage for the subroutines required by the object program.

The IBM 1130 Basic FORTRAN IV language is compatible with and encompasses the United States of America (USA) Basic FORTRAN.

Subroutine Library

The subroutines for 1130 Computing System are a package of commonly used routines for data input/output, data conversion, and arithmetic functions. The subroutines required for operation of an object program are selected by the relocating loader or core-image converter program when the object program is being processed.

A complete listing of the subroutines is in the *IBM 1130 Subroutine Library*, GC26-5929. The following lists are not exhaustive; they merely indicate the variety of the subroutines that are available. Subroutines for input/output data transfer and control operations include:

- Card read punch
- Disk
- Printer
- Console keyboard
- Console printer
- Paper tape
- Plotter
- Synchronous communications adapter

Arithmetic and functional subroutines, which are divided among the categories of floating point, fixed point, special function, and miscellaneous, include such subroutines as:

- Add/subtract
- Multiply
- Divide
- Trigonometric sin/cosine
- Trigonometric arctangent
- Square root
- Natural logarithm
- Exponential (e^x)
- Normalize
- Real arithmetic range check
- Integer base to an integer exponent
- Real reverse subtract
- Real absolute value
- Get parameters

In addition, *conversion* subroutines are used to convert data from and to the codes of the input/output devices that can be attached to the system.

Additional Machine Requirements: In addition to the machine requirements previously listed for the 1130 system programs, one or more of the following units may be *required* for operation of the supporting subroutine. (For example, the plotter subroutine *requires* that the IBM 1627 Plotter be attached to the 1130 Computing System.)

- IBM 1132 Printer
- Single Disk Storage
- IBM 1627 Plotter
- Synchronous Communications Adapter

Utility Routines

The utility routines for the Card/Paper Tape Programming System are:

Input/output routine
Dump routines
Console routine
Load routines
Keyboard routine
Card reproducing routine
Disk pack initialization routine
Construct paper tape routine

The *input/output routine* performs the function of transferring information from one medium to another or to combinations of others. Input is accepted from cards or paper tape. Output can be to the console printer, 1132 Printer, paper tape, or card.

The *dump routines* are used to output all or part of core storage to an output device, namely: card punch, console printer, or the 1132 Printer. Any area of core storage may be dumped. The output can be in either decimal or hexadecimal form.

The *console routine* is a program testing aid which allows dumping of selected portions of core storage. This routine, available only in the card system (*not* in the paper tape system), is contained in one card and requires only 80 words of core storage. All output is in hexadecimal form on the console printer.

The *loading routines* are used to load the output of the symbolic assembler or the FORTRAN compiler. The *relocating loader* accepts output directly from the compressor or compiler and loads the object program and the required subroutines to core storage for program execution.

The compressor or compiler output must be acted upon by the *core-image converter program* before the object program can be loaded by the *core-image loader*.

The *keyboard routine* is designed to assist the user in preparing source documents on cards or paper tape with the keyboard of the console typewriter. The size of the record for card output is limited to 80 characters and maximum record length for paper tape output is 3648 characters. Cards are punched in IBM card code (12 bit). PTTC/8 is the output code for tape.

The *card reproducing routine* is designed to reproduce cards from 1130 assembler source cards. This routine is extremely useful to customers who do not have off-line card-reproducing facilities. A header card is placed in front of the deck to be reproduced. The presence or absence of punched columns in the header card determines which columns in each card of the deck will be reproduced. If all 80 columns are to be punched, the maximum number of cards that can be punched at one time is 43 in a 4k system; in an 8k system, about 94 cards can be punched from each buffer load. If only one column is to be punched, the maximum number of cards is 3500.

The *disk pack initialization routine* performs the following functions:

- Writes disk sector addresses on all cylinders
- Determines which if any sectors are defective and writes the address (es) of the cylinders containing the defective sectors on sector 0000
- Establishes a file-protected area for the disk pack
- Puts an ID (identifier) in the disk pack

The *construct paper tape routine* allows the user to:

- Combine tapes
- Delete subroutines that are not required from the subroutine library tape
- Delete overlay records (required by the relocating loader) from a library tape for input to the core image converter
- Reproduce tape if the input tape is in a specified format
- List routine names from input tape on the console printer

1130/1800 Compatible Programs

Programs can be prepared on the IBM 1130 Computing System for execution on the IBM 1800 Data Acquisition and Control System. Programs for the 1800 can be assembled and compressed or FORTRAN-compiled on the 1130 using the 1130 Card/Paper Tape programming systems. These programs, in relocatable card or paper tape form, can be executed on the 1800 using the 1800 Relocating Loader and 1800 Subroutine Library.

This compatibility applies only to relocatable object programs produced by the 1130 Card/Paper Tape Programming Systems. The compatibility does not apply to the programming systems themselves. The 1130 Card/Paper Tape Programming Systems contain differences in input/output operation such that they cannot generally be used on the 1800.

IBM 1130 DISK MONITOR SYSTEM, VERSION 2

The IBM 1130 Disk Monitor System, Version 2, is a disk-oriented programming system that enables the user to assemble, compile, and execute programs written in assembler, FORTRAN IV, or 1130 RPG (Report Program Generator) programming language. The programming system provides the ability to combine assembler language subprograms or FORTRAN subprograms into assembled or FORTRAN-compiled main programs in any combination. The commercial capabilities of the 1130 Computing System can be more effectively realized through use of the 1130 RPG language and the 1130 RPG compiler system, which is a disk-resident component of the Disk Monitor Programming System, Version 2. Assembler language coded subroutines are supported with 1130 RPG.

The IBM 1130 Disk Monitor System, Version 2, supports the following 1130 system units:

- IBM 1131 Central Processing Unit Models 1B–5D
- IBM 1132 Printer Model 1 or 2
- IBM 1134 Paper Tape Reader
- IBM 1055 Paper Tape Punch
- IBM 1231 Optical Mark Page Reader
- IBM 1403 Printer Model 6 or 7
- IBM 1442 Card Punch Model 5
- IBM 1442 Card Read Punch Model 6 or 7
- IBM 1627 Plotter Model A1 or A2
- IBM 2310 Disk Storage Models B1 and B2
- IBM 2311 Disk Storage Drive Models 11 and 12
- IBM 2501 Card Reader Model A1 or A2
- Synchronous Communications Adapter
- IBM 2250 Display Unit Model 4 (using the 1130/2250 Graphic Subroutine Package. See the section of this manual devoted to the Graphic Subroutine Package.)

The IBM 1130 Disk Monitor System, Version 2, allows the user to assemble, compile, and/or execute one program or a group of programs with a minimum of operator intervention. Jobs to be performed are stacked and separated by control records that identify the operation to be performed.

The remainder of this section is a brief description of the IBM 1130 Disk Monitor, Version 2. For a more complete description, refer to the Systems Reference Library publication *IBM 1130 Disk Monitor System, Version 2, Programming and Operator's Guide, GC26-3717*.

The IBM 1130 Disk Monitor System, Version 2, is made up of:

- Supervisor program
- Disk utility program
- Assembler program
- FORTRAN IV compiler
- 1130 RPG compiler
- System library
- Core image loader
- Core load builder

Additional programs, that are more specialized in nature, such as the Graphic Subroutine Package, are summarized in subsequent sections of this publication.

Machine Requirements

The minimum system configurations required to operate the IBM 1130 Disk Monitor System, Version 2, include:

- 1131 Model 2A CPU
 - 1134 Paper Tape Reader
 - 1055 Paper Tape Punch
- or*
- 1131 Model 2A or 4A CPU
 - 1442 Card Read Punch, Model 6 or 7
- or*
- 1131 Model 1B CPU
 - 1133 Multiplex Control Enclosure
 - 2311 Model 12 Disk Storage Drive
 - 1442 Card Read Punch Model 6 or 7, or a 2501 Card Reader in combination with a 1442 Card Punch Model 5

Monitor Components

The IBM Disk Monitor System, Version 2, coordinates CPU activity by establishing in core storage a common communications area, which is used by the various programs that make up the monitor system. It also guides the transfer of control between the various monitor programs and the user's programs. Operation is continuous and setup time is reduced to a minimum, thereby effecting a substantial time saving in CPU operation and allowing greater programming flexibility.

The *supervisor* program provides the linkage between user programs and monitor programs. The supervisor program reads and analyzes control records and transfers control to the proper program.

The *assembler* program converts user-written symbolic-language source programs into actual machine-language object programs. The disk monitor assembler performs the same functions as the Card/Paper Tape Programming System programming language. The disk-monitor assembler, however, assembles the source deck in one pass, producing an object program on the disk in addition to printing a listing. It allows labels to overflow onto disk, if necessary, and produces more instruction types than the Card/Paper Tape system.

The IBM Macro Assembler is a direct extension of, and a replacement to the existing Disk Monitor System, Version 2, Assembler (ASM). This facility is entirely compatible in syntax and language usage with the existing ASM. This macro facility:

- Introduces high level language capability, as specified by the user
- Decreases user programming effort through the development of his own application or systems oriented macro libraries
- Enables the user to create a language suitable to his unique environment

The Macro Assembler facility requires an additional five disk cylinders for residence beyond the space now required for the assembler program. Also, 8k of core storage is required for the macro features.

The *FORTRAN* compiler converts user-written FORTRAN-language source programs into actual machine-language object programs.

The *1130 RPG* compiler converts user-written, RPG-language source programs into actual machine-language object programs. This system extends the commercial capabilities of the system and provides a language which is easy to learn and specifically oriented to commercial applications.

The support provided by 1130 RPG consists of a problem-oriented symbolic language and a compiler program. The user describes his problem by coding source statements on RPG coding forms, which describe the input and output files, records and fields, and the data processing that is to be performed. The compiler program converts these source statements to an object program with subroutine linkages. The object program in turn is executed to accomplish the problem solution.

The 1130 RPG uses the same coding forms as System/360 RPG and provides similar functional capabilities. Language compatibility is dependent on the RPG functions supported, the devices supported by the system, and the differing control program requirements. The 1130 RPG introduces new or improved functions as follows:

- Simplified specification of editing functions
- Retrieval of records from index-sequential or sequential files during calculations
- Subroutines for use in certain repeated calculation routines (The use of assembler language coded subroutines is also supported.)
- Capability of outputting records as often as desired during detail and total calculations

The *system library* is a group of disk-resident subprograms and mainline programs that perform input/output, conversion, arithmetic, disk initialization, disk maintenance functions, and disk data file conversion. (A paper tape utility program is also included in the system library.) Subroutines used with the Disk Monitor System, Version 2, provide broad functional capabilities, beyond those of the subroutines provided for use with the Card/Paper Tape Programming System. A representative list of subroutines is in the Subroutine Library section under the Card/Paper Tape Programming System description in this manual. Complete lists and descriptions of the subroutines available with the Disk Monitor System, Version 2, are in the *IBM 1130 Subroutine Library*, GC26-5929.

The system library also contains subroutines that operate the synchronous communications adapter in synchronous transmit-receive (STR) mode or binary synchronous communication (BSC) mode. Subroutines are provided to communicate with the following equipment:

- IBM System/360 Models 25, 30, 40, 50, 65, 67 (in Model 65 mode), 75 or 85 by means of an IBM 2701 Data Adapter Unit or an IBM 2703 Transmission Control in BSC mode
- IBM System/360 Models 25, 30, 40, 50, 65, 75 or 85 by means of an IBM 2701 Data Adapter Unit in STR mode
- IBM System/360 Model 25 by means of its integrated communications attachment in BSC mode
- IBM System/360 Model 20 by means of its communications adapter in STR mode
- Another 1130 Computing System by means of that system's synchronous communications adapter in BSC or STR mode
- IBM 1009 Data Transmission Unit in STR mode
- IBM 1013 Card Transmission Terminal in STR mode
- IBM 7702 Magnetic Tape Transmission Terminal in STR mode
- IBM 7711 Data Communication Unit in STR mode

Note: For some of the preceding listed equipment, the character set may be slightly different from that of the IBM 1130 Synchronous Communications Adapter. These differences are not supported in the 1130 subroutines.

The *disk utility program* (DUP) is a group of routines designed to assist the user in storing information (data and programs) on the disk and retrieving and using the information stored. The Macro Update Program provides users of the 1130 Macro Assembler full macro library maintenance facilities. For this feature of DUP, 8k main storage is required.

Other *utility* programs (special purpose programs stored on cards or paper tape) include programs for:

- Dumping from core to printer
- Dumping from disk to printer
- Initializing disk cartridges
- Copying one disk cartridge to another

The *core image loader* is the program that is called to process the three entries to the skeleton supervisor—LINK, DUMP, and EXIT (the skeleton supervisor is a part of the resident monitor and is thus core-resident). The core image loader is assigned this task in order to achieve the fastest possible link-to-link transfer of control via CALL LINK.

On a LINK entry to the skeleton supervisor, the core image loader handles the locating and fetching of the core load and the calling of the core load builder, if necessary. On an EXIT or DUMP entry, the core image loader calls the appropriate supervisor program into operation and the system continues to the next job or dumps requested data on the principal print device.

The *core load builder* builds a specified mainline program into an executable core load. The mainline program, with its required subprograms, is converted from disk system format to disk core image format. The resulting core load is suitable for immediate execution or for storing on the disk in disk core image format for future execution.

ADDITIONAL SUPPORT

Graphic Subroutine Package

The Graphic Subroutine Package (GSP) consists of subroutines for generating and displaying characters or graphic forms on the 2250 Display Unit Model 4, screen and for controlling communication between the program and the 2250 operator. The subroutines are grouped into the following:

- Image management subroutines
- Image generation subroutines
- Attention-handling subroutines
- Entering data with the alphameric keyboard
- Entering data with the light pen
- Entering data with the programmed function keyboard
- Error handling
- Assembler language facilities

The subroutines may be called from a program written in the 1130 Basic FORTRAN IV language or from a program written in 1130 assembler language. (See the SRL publication *IBM 1130/2250 Graphic Subroutine Package for Basic FORTRAN IV*, GC27-6934.)

Programs using the GSP may be executed on any 1130 Computing System that has 8192 words of main storage, a disk, and an attached IBM 2250 Display Unit Model 4.

Satellite Graphic Job Processor

The Satellite Graphic Job Processor (SGJP) permits Operating System/360 job definition and initiation from a 2250 Display Unit Model 4, attached to a remote 1130 Computing System. SGJP enables the user who is unfamiliar with either the 1130 or Operating System/360 to define an Operating System/360 job to run in conjunction with a related 1130 program. Operating System/360 system messages are routed by SGJP to the 1130 for optional printing. The programming to transmit control information and data between the programs in each processor is not provided by SGJP but must be part of the application. FORTRAN subroutines for data transmission between a System/360 and an 1130 system are normally used for this purpose. (Refer to the associated section of this manual.)

SGJP can also be used to specify and queue Operating System/360 jobs for normal batch processing under MFT II or MVT from the 2250. (MFT stands for Multi-programming with a Fixed Number of Tasks; MVT stands for Multi-programming with a Variable Number of Tasks. Both MFT and MVT are supervisors in the Operating System/360. Refer to the *IBM System/360 and System/370 Bibliography*, GA22-6822, for a listing of publications that describe programming systems for the IBM System/360.) Output from such jobs is produced as normal Operating System/360 output, and not routed to the originating 1130.

SGJP is an extension of the Operating System/360 Graphic Job Processor (GJP).

Up to fourteen remote 1130/2250 systems can be attached to a System/360 for SGJP operations. SGJP facilitates the initiation of jobs by requesting Operating System/360 and the related 1130 job control information from a user through a series of displays. The user responds to the displays by entering information or by selecting appropriate options with the light pen or the alphameric keyboard. Job control information for an Operating System/360 job is transmitted to the Operating System/360, converted to Job Control Language, and used to initiate the desired job in a region or partition associated with the 1130/2250 subsystem. Information about an 1130 program is used to initiate that program in the 1130.

SGJP enables the remote 1130/2250 user to:

- Identify himself to the Operating System/360
- Define and start execution of an Operating System/360 procedure as a job
- Define an Operating System/360 program or cataloged procedure to be executed as a job step
- Define data sets to be used by the Operating System/360 program
- Define an 1130 program to run in conjunction with the Operating System/360 program
- Start execution of the specified Operating System/360 and 1130 programs
- Communicate with the Operating System/360 operator
- Enter 80-character data records to be used by the Operating System/360 program
- Delete a job he is currently defining, but has not yet initiated
- Re-examine previously completed job control operations
- Conclude his job definition and prepare the 2250 for the next user

System requirements for SGJP are:

- An IBM 1130 Computing System including
 - The 1130 Disk Monitor System, Version 2
 - An 1130 Computing System with at least 16k of core storage and the synchronous communications adapter
 - An 1132 or 1403 Printer if a printed record of operations is desired
 - A 1442 Card Read Punch, or a 2501 Card Reader and a 1442 Card Punch
- A 2250 Display Unit Model 4 equipped with the light pen and alphameric keyboard
- Operating System/360 MFT-II or MVT
- A 2701 Data Adapter Unit or 2703 Transmission Control Unit capable of supporting BSC in half-duplex, point-to-point environment. The 2701 or 2703 must be designated for use with EBCDIC. Users of the dual communications interface on the 2701 must specify the 1130/2250 subsystem line as interface A.

Users who desire to employ switched network data sets are required to perform their own manual- or program-controlled procedures to establish the point-to-point environment necessary for the data transmission.

FORTRAN Subroutines for Data Transmission Between a System/360 and an 1130 Computing System

These routines provide for data transmission between an IBM System/360 and a remote 1130 Computing System over established communication lines. The user, by means of FORTRAN CALL statements, can transmit control information and data between two programs, one in the 1130, and one in the System/360. These programs are normally started in each processor by the Satellite Graphic Job Processor but can be started by other procedures.

Use of the transmission subroutines makes it possible for an 1130 program to use the high speed computational capability and large storage capacity of Operating System/360, thus increasing the flexibility and efficiency of the 1130 application.

The transmission subroutines use Operating System/360 Basic Telecommunications Access Method (BTAM) facilities and a specialized synchronous communications adapter subroutine under the 1130 Monitor System, Version 2, to accomplish the actual data transmission. However, the FORTRAN programmer can program the data communication with no knowledge of binary synchronous communications. The transmission subroutines enable the Operating System/360 FORTRAN programmer to:

- Initialize the communications lines
- Read and write data via the communications lines
- Test the status of the previous request for a read or write operation
- Activate a user-written synchronous routine in the 1130
- Terminate the 1130 mainline program
- Logically terminate the communications hookup

Similar functions are performed by transmission subroutines available to the 1130 FORTRAN programmer, except that the 1130 does not have the facility to terminate an Operating System/360 program.

Remote Job Entry Work Station

The 1130 Remote Job Entry (RJE) Work Station program, operates within the 1130 Disk Monitor System, Version 2, environment. The 1130 RJE program can enter Operating System/360 jobs from a remote 1130. The jobs can then be executed on a central System/360 Model 50, 65, 67 (in Model 65 mode), 75 or 85. The program reads job input and RJE commands from an attached input device, transmits data to and receives data from the central processor, and writes output to an attached printer, punch or disk. As an option, disk output may be replaced by a user-written routine. If a user-written output routine is included, 16k words of main storage is normally required. However, a limited user-written routine can be included in an 8k machine, depending on the configuration. The 1130 RJE program operates with Remote Job Entry under Operating System/360. Communication is in binary synchronous mode on a point-to-point leased line, a multipoint leased line, or on a point-to-point switched network.

The minimum system requirements are:

- An 8k word 1131 model 2 or 3
- 1442 Card Read Punch Model 6 or 7, or 2501 Card Reader Model A1 or A2, and 1442 Card Punch Model 5, or 1442 Card Read Punch Model 6 or 7
- 1132 or 1403 Printer
- Synchronous Communications Adapter

The devices that can be utilized are:

- 1442 Card Read Punch Model 6 or 7
- 2501 Card Reader Model A1 or A2
- 1442 Card Punch Model 5
- Keyboard/Console Printer
- 1132 Printer
- 1403 Printer Model 6 or 7
- 2310 Disk Storage Models B1 and B2
- 2311 Disk Storage Drive Models 11 and 12
- Single Disk Storage (in the 1131)
- Synchronous Communications Adapter

1130 Distributed System Program

The 1130 Distributed System Program provides subroutines for controlling the exchange of programs and data between an 1130 system and a System/7. The package contains the following:

General control subroutines
Request control subroutines
Transmission control subroutines
Interface control subroutines
Utility programs

The subroutines may be called from programs written in 1130 Assembler or in the 1130 FORTRAN language.

Programs using the 1130 Distributed System Program can be executed on any IBM 1130 Computing System that meets the minimum requirements of IBM 1130 Disk Monitor System, Version 2 and has an attached IBM System/7.

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- IBM 1403 Printer 7
- IBM 1442 Card Punch 5
- IBM 1442 Card Read Punch 4
- IBM 1627 Plotter 10
- IBM 2310 Disk Storage 7
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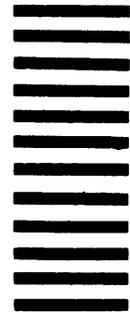
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