File No. 1130-00
Form A26-5917-3

IBM Systems Reference Library

IBM 1130 System Summary

The System Summary presents a brief introduction to the IBM 1130 Computing System, including system concepts, components, and programming systems. Intended as a general, overall picture of the 1130, the manual helps the reader gain a basic understanding of the system and its use.

Copies of this and other IBM publications can be obtained through IBM Branch Offices.
Comments concerning the contents of this publication may be addressed to:
IBM, Product Publications Department, San Jose, Calif. 95114

CONTENTS

INTRODUCTION 1

SYSTEM UNITS AND FEATURES 2
IBM 1131 Central Processing Unit 2
Core Storage 2
Instructions 2
Interrupt 2
IBM 1442 Card Read-Punch 2
IBM 1132 Printer 2
IBM 1054 Paper Tape Reader 3
IBM 1055 Paper Tape Punch 3
IBM 1627 Plotter 4

PROGRAMS AND PROGRAMMING SYSTEMS 5
Machine Requirements 5
Assembler 5
Fortran 5
Subroutine Library 5
Input/Output 6
Functional Subroutine 6
Arithmetic 6
Conversion 6
Additional Machine Requirements 6
UTILITY ROUTINES 6
MONITOR SYSTEM 6

The IBM 1130 Computing System provides the capacity and versatility to accomplish the 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 Computer System is also ideally suited to small commercial data processing applications.

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 by engineering and research personnel for solutions to problems in individual projects. In addition, programs and programming systems, supplied by IBM, relieve the user of detailed programming and provide 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 of 4,096 or 8,192 16-bit words. An additional 512,000 words of storage is available on-line with the disk storage feature of the 1131 Model 2. Disk storage provides random or sequential access to data; the interchangeable disk cartridge places the required information at the disposal of the system and allows virtually unlimited off-line storage capacity. The CPU also includes a console with data displays and switches for operator control, a keyboard for data entry, and a console printer.

The basic 1130 System consists of the CPU and either the IBM 1442 Card Read-Punch or the IBM 1054 Paper Tape Reader and the IBM 1055 Paper Tape Punch. To either of these configurations can be added: disk storage, additional (4,096 words) core storage (total 8,192), an IBM 1627 Plotter, and the IBM 1132 Printer. Paper tape or card units not already a part of the basic system can also be added.

The following sections of this manual present summary descriptions of the components of the 1130 Computing System and the associated programs and programming systems. The publication, IBM 1130 Computing System Bibliography (Form A26-5916) contains a list of publications that present more detailed operating and programming information on each part of the system.

40 ms. per rev.
200 tracks
321 words/track 4 sectors/track.
35 K w/sec.
15 ms. for 1 or 2 track, track positioning time.
540 ms. max positioning time.

DISK
2310 — 512K — 16 bit
2311 — 7.25M — 8 level
2314 — 8 modules of 2311 disks —

IBM 1131 CENTRAL PROCESSING UNIT

Two models of the 1131 CPU are available (Figure 1).

Model 1 has 4,096 16-bit words of core storage; an additional 4,096 words are available as a special feature. A versatile extensive console presents to the operator displays that show the data in the various registers, counters, and other storage areas of the machine. Switches provide for control of the operation and the entry of data. Data can also be entered from the console keyboard. The console printer provides printed output of data in core storage.

Model 2 of the 1131 CPU has all of the features of the Model 1 plus disk storage. Disk storage is an auxiliary storage device for the 1130 System. Housed in the CPU enclosure, disk storage consists of a single disk drive and a removable disk cartridge. Capacity of the disk is 512,000 16-bit data words. The data transfer rate is 700,000 bits per second, or 28.6 μsec (microseconds) per word. The removable disk cartridge allows data and program routines to be put on-line as needed; additional cartridges provide virtually unlimited storage, available as required.

Core Storage

The 4,096 or 8,192 16-bit words in core storage are individually addressable. Words 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 $2^{31}-1$; the largest negative number is -2^{31}.

The memory cycle time is 3.6 μsec.

Instructions

The 1131 instruction set consists of 29 discrete instructions. Single or double 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. Address modification and indirect addressing facilities are available for programming use.

Interrupt

The interrupt operation of the 1130 System allows each input/output device to operate at maximum speed consistent with the programmed operation and makes the CPU available except during the actual transmission of data. Up to six levels of interrupt priority are provided. The number of levels for any given system depends upon the configuration. In addition to the interrupt levels, disk storage operates on a high-speed data channel that transmits data to and from the CPU on a cycle-stealing basis.

All transfers into and out of core storage are parity checked to ensure accuracy of transmission.

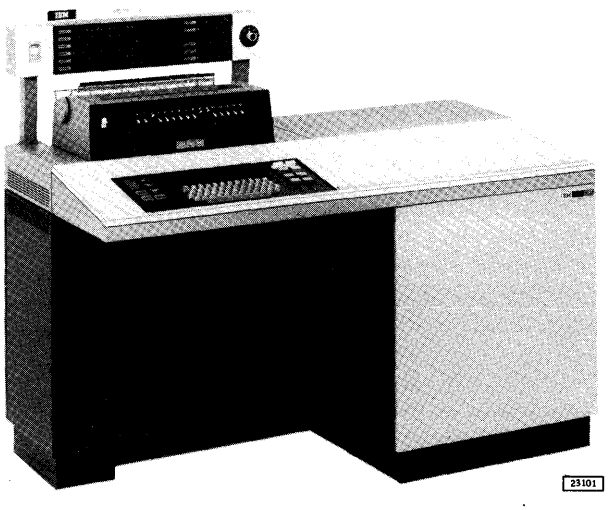

Figure 1. IBM 1131 Central Processing Unit

IBM 1442 CARD READ-PUNCH

The 1442 (Figure 2) provides serial reading and punching of cards. Two models are available for attachment to the 1130 System.

Model 6: Read - 300 cards per minute
Punch - 80 columns per second
Model 7: Read - 400 cards per minute
Punch - 160 columns per second

IBM 1132 PRINTER

The 1132 Printer (Figure 3) 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 at the rate of

*NOTE: The illustrations in this manual have a code number in the lower corner. This is a publishing control number and is unrelated to the subject matter.

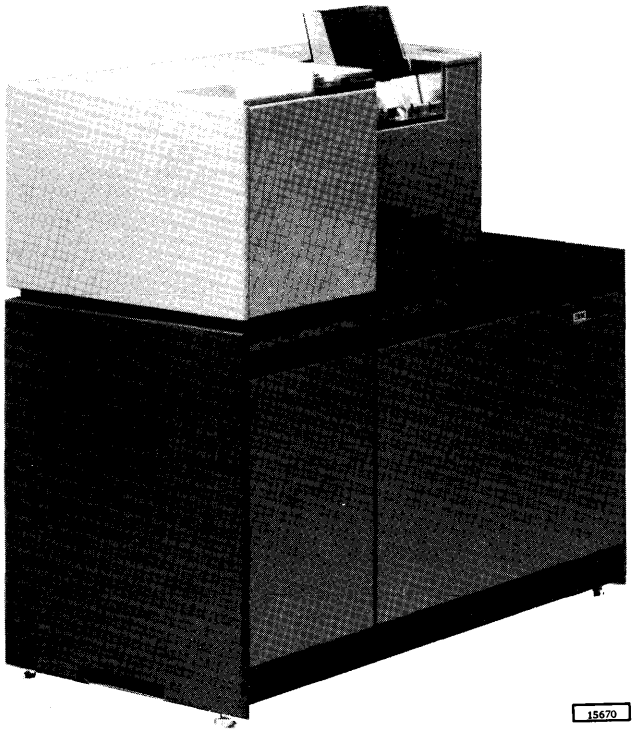

Figure 2. IBM 1442 Card Read-Punch

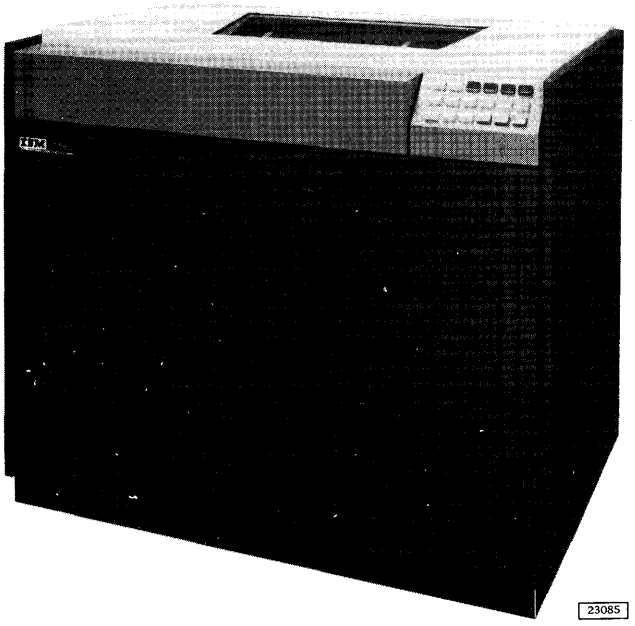

Figure 3. IBM 1132 Printer

80 lines per minute while consecutive all-numeric lines of data are printed at the rate of 110 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.

IBM ~~1054~~ 1034 PAPER TAPE READER

The 1054 Paper Tape Reader (Figure 4) reads one-inch eight-channel paper tape at the rate of ~~14.8~~ 60 characters per second. Data is read into central processing unit core storage as an image of the holes in the tape. Each punched character is read into one addressed core storage location. Translation of the character code placed in core storage is accomplished through programming.

IBM 1055 PAPER TAPE PUNCH

The 1055 Paper Tape Punch (Figure 5) 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-to-character basis.

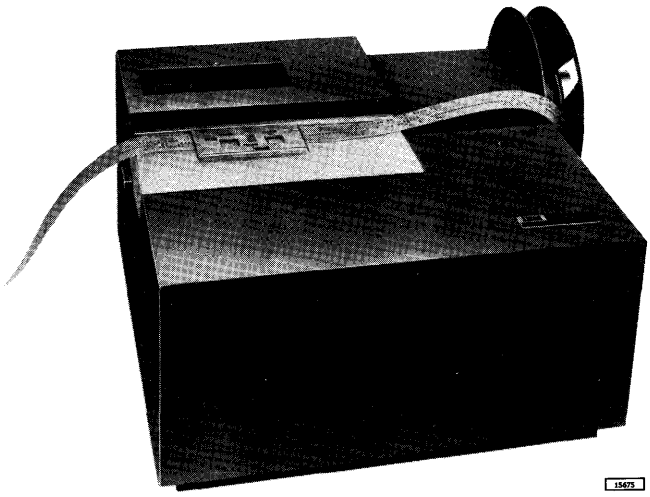

Figure 4. IBM 1054 Paper Tape Reader

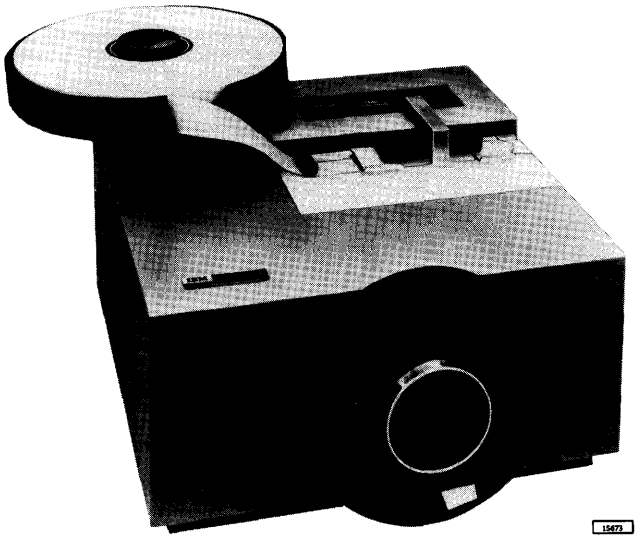

Figure 5. IBM 1055 Paper Tape Punch

IBM 1627 PLOTTER

The 1627 (Figure 6) 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.

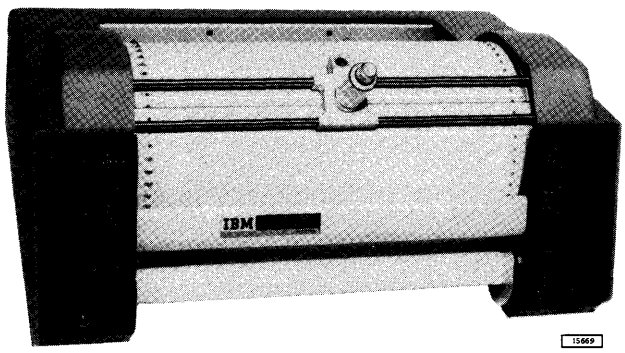

Figure 6. IBM 1627 Plotter

Model 1 - Plotting Area: 11 inches by 120 feet
Increment: 1/100 inch steps at
300 steps/second.

Model 2 - Plotting Area: 29-1/2 inches by 120 feet.
Increment: 1/100 inch steps at
200 steps/second.

IBM provides 1130 System users with a powerful set of programs and programming systems. They are specifically designed to relieve the user of much detailed programming effort. This section presents a brief description of each program. Publications supplying detailed information on each program are listed in IBM 1130 Computing System Bibliography (Form A26-5916).

Machine Requirements

The minimum machine configuration required for use of any program described in this section includes:

1. IBM 1131 Central Processing Unit with a minimum of 4,096 words of core storage.
2. IBM 1054 Paper Tape Reader and IBM 1055 Paper Tape Punch, or the IBM 1442 Card Read-Punch.

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

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 which relieve the programmer of coding the machine-language instruction modifications.

Macro-instructions are included which (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.

FORTRAN

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.

SUBROUTINE LIBRARY

The subroutines for the 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.

The subroutines included in the Subroutine Library are:

Input/Output

Card
Disk
Printer (1132)
Console Keyboard
Console Printer
Paper Tape
Plotter (1627)

Functional Subroutines

Trigonometric Sine/Cosine
Trigonometric Arctangent
Square Root
Logarithm (natural)
Exponential

Arithmetic

This group includes 30 subroutines designed to augment the CPU arithmetic instructions. The subroutines perform such functions as floating-point operations for Add, Subtract, Multiply, Divide, etc. Only the subroutines required for operation of the object program are loaded to core storage during execution.

Conversion

This group includes 11 data conversion subroutines to be used to convert data from and to the various input/output codes of the I/O 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
Disk Storage
IBM 1627 Plotter

UTILITY ROUTINES

The Utility Routines for the 1130 Computing System comprise the following:

Input/Output routine
Dump routines
Console routine
Load routines

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 memory to an output device, namely: card punch, Console Printer, or the 1132 Printer. Any area of memory may be dumped; however, the first 300 words of memory contain the dump routine itself. 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 memory. This routine is contained in one card and requires only 80 words of memory. 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 assembler or compiler and loads the object program and the required subroutines to core storage for program execution.

The assembler 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.

MONITOR SYSTEM

The 1130 Monitor is a disk-oriented system that allows the user to assemble, compile, and/or execute individual 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 Monitor System requires an IBM 1131 CPU Model 2.

The Monitor System is comprised of five distinct but interdependent programs:

Supervisor Program
Disk Utility Program
Assembler Program
FORTRAN Compiler
Subroutine Library

The Supervisor program provides the necessary control for the stacked-job concept. In other words, it reads and analyzes the control records, and transfers control to the proper program.

The Disk Utility Program 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 Assembler Program converts user-written symbolic-language source programs into actual machine-language object programs.

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

The Subroutine Library contains pre-written subroutines for data input/output, data conversion, and arithmetic functions.

The Monitor System coordinates CPU activity by establishing a common communications area in memory 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.

		PAPER TAPE	CARD
BASIC	4K MODI	31,815	42,830
ADD	4K	8,400	8,400
ADD	DISK	9,090	9,090
ADD	SAC + TIMER	2,965	2,965
ADD	PLOTTER	5,375	5,375
ADD	PRINTER	12,375	12,375

1,310 MORE PAPER TAPE

IBM 1130 Printed in U.S.A. A26-5917-3

IBM

International Business Machines Corporation
Data Processing Division
112 East Post Road, White Plains, N. Y. 10601