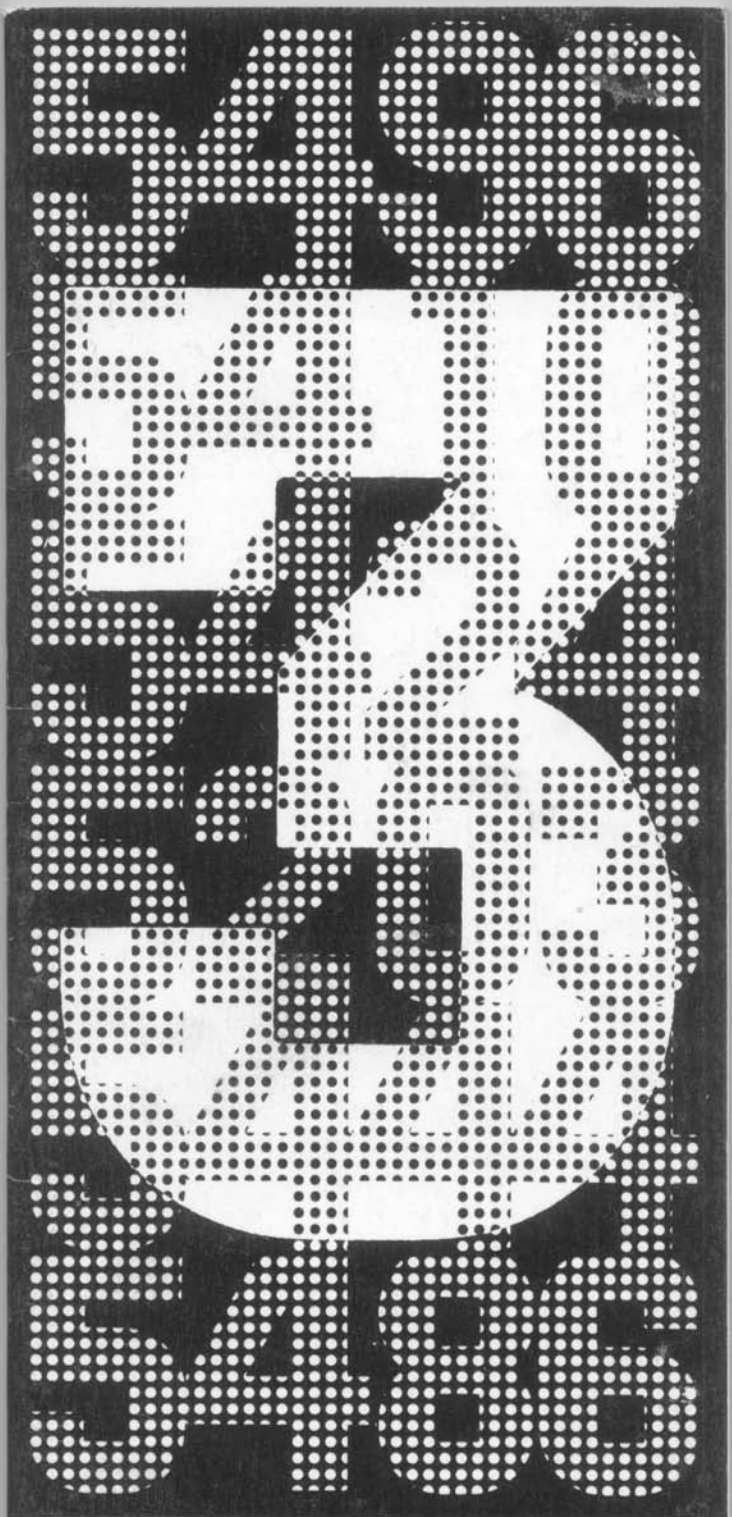


IBM field engineering announcement

System/3

IBM System/3 is a new advanced unit-record system that performs familiar punched-card processing such as reading, punching, reproducing, sorting, collating, interpreting, printing and calculating but with greater versatility than was previously possible with IBM unit-record equipment. With the introduction of the 96-column card and the application of advanced circuit technology, System/3 offers the advantages of more information per card while requiring less space for card filing and hardware.

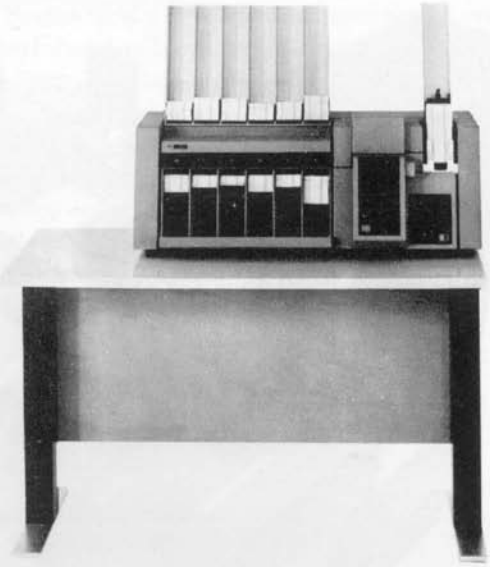
System Components
IBM 5410 Processing Unit
IBM 5424 Multi-Function Card Unit
IBM 5203 Printer

Optional Machine Types
IBM 5444 Disk Storage Drive
IBM 5471 Printer Keyboard
IBM 5475 Data Entry Keyboard

Off-Line Components
IBM 5496 Data Recorder
IBM 5486 Card Sorter

Technology
The speed and reliability of System/3 are made possible by use of micro-miniaturized circuit modules of the Monolithic System Technology (MST) family. MST circuits can be switched at an average speed of 10 nanoseconds (one nanosecond equals one billionth of a second). An advanced form of Solid Logic Technology called Solid Logic Dense (SLD) is used in the Data Recorder, Sorter and some of the I/O boxes.

Off-line Components



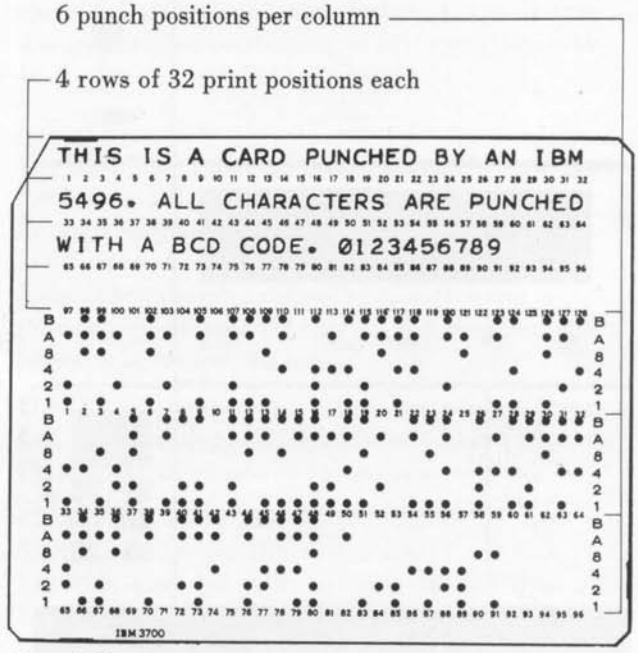
IBM 5486 Card Sorter

IBM 5496 Data Recorder

96-Column Card

The new card used with System/3 combines an increased capacity (96 columns) yet is only about one third the size of the regular 80-column punched card. (The 96-column card measurements are 3.250 inches wide, 2.630 inches high, and 0.007 inch thick.) This card makes it possible to have compact high performance card equipment while decreasing the card storage requirements.

The 96-column card has three tiers of columns with 32 columns in each tier. Each column contains six punch positions for the BCD 6-bit card code (BA8421). At the top of the card are four rows of 32 print positions each.

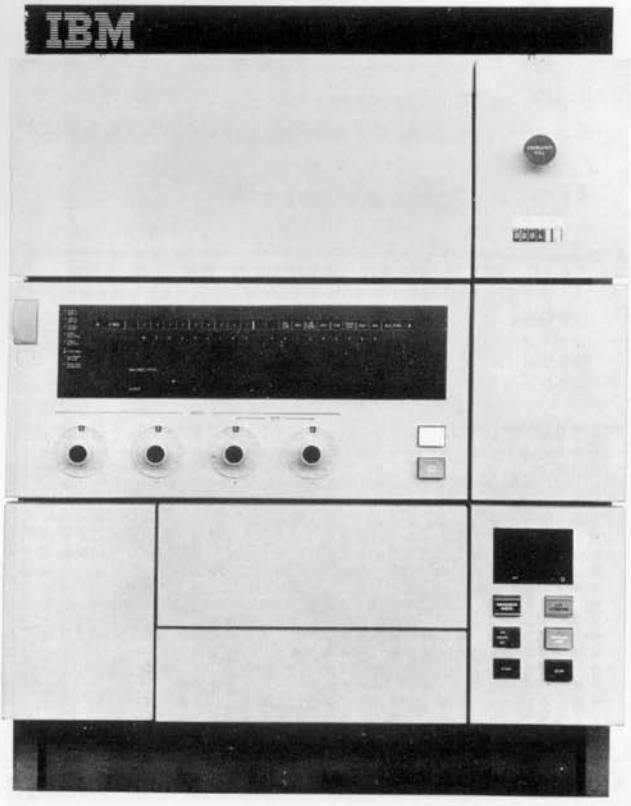


Actual Size

5410 Processing Unit

Description
The 5410 Processing Unit contains the facilities for addressing storage and performing arithmetic and logical processing of data. It also controls the transfer of data between main storage and attached input/output (I/O) devices.

In addition to main (core) storage, the 5410 contains a set of general and local store registers which store information pertinent to the execution of program instructions. The local store registers are high speed, latch type registers.



Arithmetic and logical operations are performed by the storage-to-storage concept; that is, data is brought out of main storage, processed in the arithmetic and logical unit (ALU), and returned to main storage.

The basic unit of information in System/3 is the byte which represents one alphabetic, numeric, or special character. The card column format (BA8421) is translated by the 5410 to Extended Binary Coded Decimal Interchange Code (EBCDIC) for internal processing unit operation. EBCDIC, also used in the IBM System/360, has a basic code structure of eight bits plus a parity bit in each byte (P01234567).

The 5410 exercises direct control over all I/O devices attached to it. Thus I/O operations are started, stopped, or tested by program instructions which specify what operation is to be performed (read, print, punch, etc).

The 5410 communicates with the attached I/O devices via an I/O channel unique to System/3. The channel discipline allows overlapping of I/O operations with each other and with 5410 processing.

Special Features
The Dual Programming Feature is available to systems that have a 5444 disk storage drive attached. Dual Programming allows the 5410 processing unit to execute two independent programs concurrently. Independent operator control of each program is provided by switches for starting and stopping, and indicator lights for halt identification.

The CE console contains two switches to help diagnose dual programming problems. These switches allow the CE to select which one of the two programs will be executed.

SIOC (Serial Input/Output Channel)
The SIOC provides additional flexibility for System/3 by allowing the attachment of various I/O devices.

Specifications

Storage: Memory sizes are available in 8K, 12K, 16K, 24K or 32K.

Timing: Basic machine cycle time (read/compute/write) is 1.52 microseconds.

Data Format: Decimal data is represented by individual bytes. Maximum length of a source decimal field is 16 digits (or bytes). The destination or result field can be 31 digits (or bytes). Binary data can have fixed length of one or two bytes or variable length up to a maximum of 256 bytes.

Instruction Formats: These formats can be 3, 4, 5, or 6 bytes in length according to the type of instruction and addressing made.

Decimal Operations: The operations are zero and add, add, and subtract. Multiplication and division are done by RPG II.

I/O Control: The 5410 CPU controls all I/O operations through the I/O channel and I/O attachment interface.

System Controls: The system controls include operator controls, a CE panel, and a display console.

Diagnostic Features

The controls on the CE panel serve as a diagnostic aid in locating hardware or software troubles. These controls display and alter information in storage as well as regulate how the 5410 performs an instruction (normal, instruction step, clock cycle, or clock step mode). Other controls for CE diagnosis include parity override, equal address stop, I/O overlap, and immediate I/O error stop. In addition to the CE panel, there is a display console that allows the operator to see the status of the 5410 control, and the contents of the various 5410 registers.

Maintenance Strategy

The maintenance strategy is an integrated maintenance plan which locates a majority of the problems without using an oscilloscope. The primary service approach is maintenance analysis procedure charts (MAPs) used in conjunction with the diagnostic programs.

The circuits are functionally packaged which facilitate the use of MAPs.

Programming

The System/3 program generating system is RPG II, a programming language and a processor program that is used to produce machine language object programs. These object programs are then used in performing a wide range of commercial data processing jobs. This RPG language has been extended beyond IBM System/360 RPG to provide major functional capabilities while maintaining compatibility with existing System/360 RPG language. These extended functions reduce the requirement for additional programming languages within this system.

Complementing the Card RPG II are:

1. Sort/Collate — A prepared utility program that can be modified by the programmer.
2. User Maintenance Program — Providing automatic maintenance and functional updating of the system.
3. 96 Column List Program.
4. 96/96 Reproduce and Interpret Program — A utility program for reproducing 96 column cards.
5. Systems Initialization Program.
6. General Purpose Card Punch Program — Simulates the 5496 Data Recorder via an optional keyboard attached to the system.
7. General Purpose Card Verify Program — Simulates the verify feature of the 5496.

Complementing the Disk RPG II are:

1. The system control and service programs — designed to generate and maintain a disk resident system. The control programs consist of a Supervisor and Scheduler. Service programs consist of library maintenance programs.

2. Systems Utility Programs
- Disk Initialization Utility — performs surface analysis and disk formatting of user's disk.
- Alternate Track Assignment Utility — allows assignment of an alternate track in place of a defective one and displays the area in error.
- Alternate Track Rebuild — permits the user to correct data on the assigned alternate track.
- File and Volume Display.
- File Delete — allows user to delete permanent files from a disk.

3. Disk Sort Program — Will support any disk file organization within the IBM System/3 in ascending and descending sequence.
4. Disk Copy/Dump — Provides an easy method of creating a file or making backup copies.
5. Card System Utilities — Resident on disk.
- General Purpose Card Punch
- General Purpose Card Verify
- MFCU Sort/Collate
- Reproduce/Interpret
- 96 Column List

The programming support diagnostic aids consist of:

1. Trace Programs
2. Dump Programs
3. Text card to printer listing with formatting program
4. Hex to text card conversion program

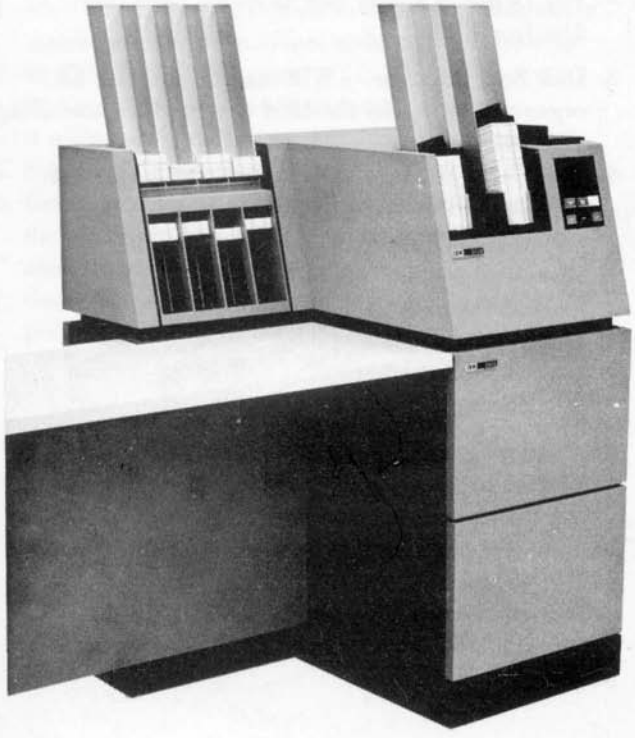
An environmental recording function within the programming systems records I/O errors and status bytes.

5424 Multi-Function Card Unit

Description

The 5424 Multi-Function Card Unit combines the facilities of a card reader, card punch, summary punch, collator, interpreter, sorter, and card printer all under control of a stored program. With two card hoppers, a photoelectric read station that reads cards from either hopper (primary or secondary), a common punch station, a print station, and four selective stackers, the 5424 gives System/3 a card-handling capacity previously possible only with the larger IBM System/360 Model 20.

Collating, gang punching, reproducing, summary punching, calculating, printing, and selective stacking can be done in one pass of the cards. Sorting requires multiple passes.



Specifications

Card Reading: Cards are read serially by 18 phototransistors and one lamp at a rate of up to 500 cards per minute* (cpm).

Card Punching: Cards are punched by 18 punches that punch three columns (one column per tier) at a time. Punching speed is up to 120 cpm*.

Card Printing: Four lines of printing, each line consisting of 32 print positions, can be printed at the top of the card. Printing is done by means of typewheels. It is possible to print any one of 64 characters in each print position. Card throughput for three rows of printing is up to 120 cpm*. Printing four rows reduces throughput to 96 cpm maximum*.

System Controls: The 5424 is attached to the 5410 processing unit I/O interface and channel and operates under control of the 5410 stored program. All control and logic circuitry is located in the 5410. Electronic components in the 5424 consist of amplifiers and drivers used for reading, punching, printing, and moving cards.

Operator Controls: The operator's console includes lights and switches for starting, stopping, controlling card runout, and indicating error conditions.

Diagnostic Features

Console Aids: Feed checks are displayed by number on the 5424 console. Each numbered indicator is associated with a specific area of the transport and the operation in process. This will assist the CE in defining transport problems to the failing unit. Other check indicators such as read and hopper are also provided.

Programming Aids: Programs are available to measure and analyze read, punch, print, and transport timings. Error analysis charts, which are symptom-oriented, are available for use with these programs to assist the CE in diagnosing hardware problems.

*A 5424 with throughput speeds up to 250 cpm read, 60 cpm punch, and 60 cpm print is also available. Printing four rows reduces throughput to 48 CPM maximum.

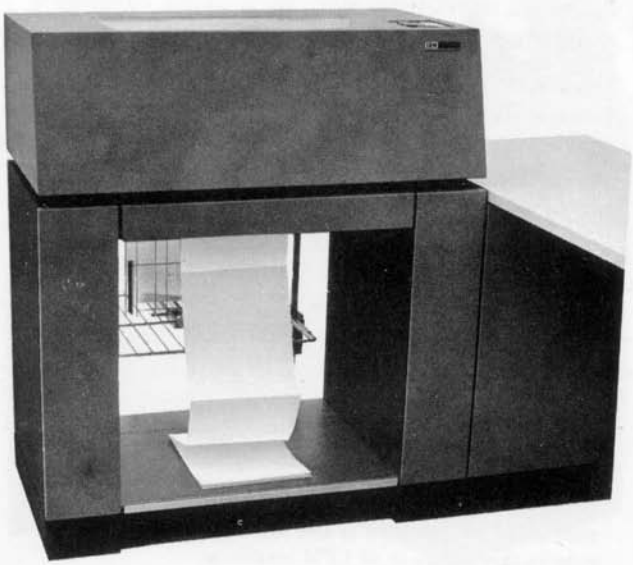
5203 Printer

Description
The 5203 Printer provides output for System/3. This is a chain type printer that is physically integrated with the system.

Printing format is controlled by the system's stored program. An interchangeable print cartridge allows the operator to select different character sets for different jobs.

An outstanding feature of the 5203 is a tapeless carriage that is controlled by the processing unit stored program. Complete electronic control of the carriage eliminates changing tapes between jobs.

Another feature of the 5203 is a unique hammer arrangement. The basic printer has 24 hammers that are spaced four print positions apart. The hammers are held in one position until all characters have been optioned to print, then moved to each of the next three positions in turn.



Special Features
Dual Feed Carriage provides a second tapeless carriage for dual form control.
Universal Character Sets are available in sets up to 120 characters (48 character set is standard).
Expanded Print Line is available in either 120 or 132 printing positions (96 are standard).

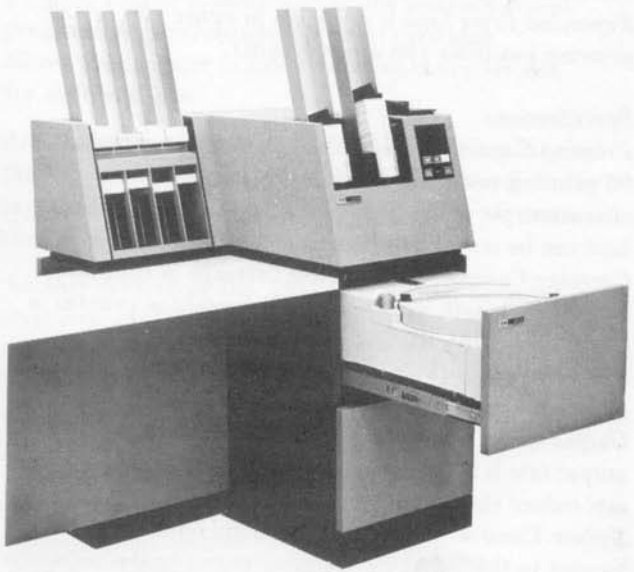
Specifications
Printing Capacity: The standard print line contains 96 printing positions. Horizontal spacing is 10 characters per inch; vertical spacing of 6 or 8 lines per inch can be manually selected by the operator.
Carriage Control: The tapeless carriage is controlled by a forms length register and a line position counter in conjunction with the 5410 stored program.
Print Cartridge: This is a chain type cartridge that is interchangeable to allow for different character sets.
Output Rate: When using a 48 character set, the output rate is 200 lines per minute.* Universal character sets reduce the rate proportionately.
System Control: All control and logic circuitry is located in the 5410; electronic circuitry in the printer is limited to drivers and amplifiers.

Diagnostic Features
Diagnostic programs monitor electronic operations in the attachment to verify proper operation and to localize failures to replaceable units. Specialized timing analysis and fault isolation programs analyze clutch response time and chain speed variations.

*A 100 lines per minute 5203 is also available.

Optional Machine Types

The IBM 5444 disk storage drive provides direct access storage capabilities for System/3. The disk drive is mounted in a sliding drawer under the 5424.



Two 14 inch disks are mounted on a common spindle. The lower disk is fixed but the upper disk can be removed. The upper disk is contained in a cartridge designed to control contamination and facilitate handling.

The disk drive capacity can be 2.46 million bytes half capacity, or 4.92 million bytes full capacity. A second disk drive can be installed in the system to give storage capacities of 7.38 or 9.84 million bytes.

The maintenance strategy is an Integrated Maintenance Plan using MAPS, Function Tests, Diagnostic Tests and Environmental Recording to help the CE isolate problems to the smallest field replaceable unit. Top CE aids include a write inhibit switch on the processing unit CE panel and a 5444 CE panel that has a rotary switch and a forward/reverse switch to manually control the disk storage drive.

The rotary switch positions are:

1 for normal operation (on line)
2 for single track access
3 for 10 track access
4, 5, 6 or 7 to facilitate scoping the output of the selected head.

The IBM 5471 printer-keyboard can be installed on systems that have an IBM 5444 disk storage drive attached. The keyboard and printer operate independently of each other under program control contributing to the 5471's flexibility.

Some of the functions it can perform are: on-line inquiry, key entry of data, operator/system communications and a secondary printer.

The IBM 5475 Data Entry Keyboard is a 64 character keyboard like that of the 5496 Data Recorder. A typical application is on-line punching and verifying.

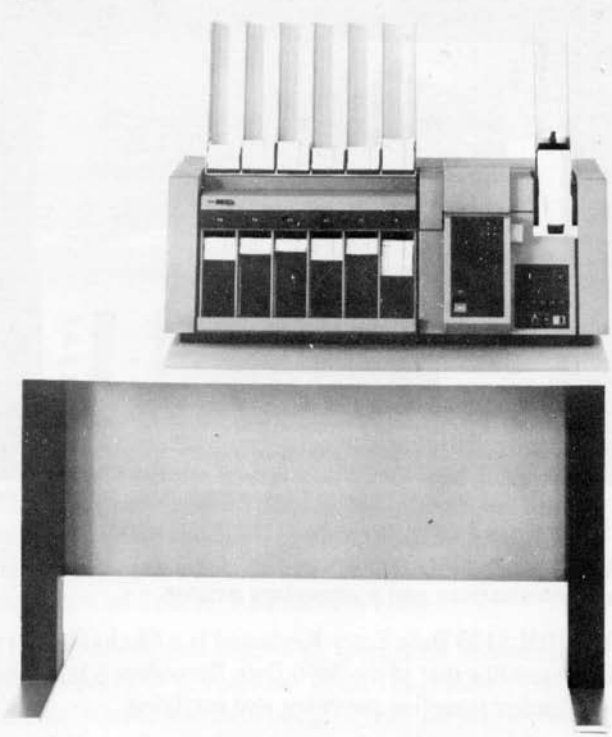
5486 Card Sorter

Description
The 5486 Card Sorter classifies or sorts 96-column cards punched with the 6-bit code into a desired sequence for use by System/3.

With the 5486 an operator can sort a file of punched cards into numeric, alphabetic, or alphameric sequence. Numeric sorting requires two card passes, whereas alphabetic and alphameric sorting require three passes.

Special Features
Alphabetic Sorting makes it possible to do alphabetic sorting in two card passes instead of three.

Auxiliary Card Counter counts cards during a pass through the machine and displays the total on the operator's console.



Digit Select allows specific digit cards to be selected into appropriate stackers without affecting the sequence of the master file.
Sort Suppress allows a card file to be sorted on any column to separate punched cards from unpunched cards while keeping the file in order.

Specifications
Card Capacity: Hopper — 2,000 cards; stackers — Approximately 600 cards each.
Speed: Sorting is done at a rate of 1500 cpm (1000 cpm sorting also available).
Read Unit: The photoelectric read unit reads one card column per tier at a time.
Pocket Selection: There is an individual selector magnet and mechanism for each stacker pocket.
Electronics: Electronic logic circuits are Solid Logic Dense (SLD) modules. All SLD cards for the sorter are mounted on one-third of an SLD board. The basic sorter has seven SLD cards.
Jam Detectors: There are six magnetic CB's along the transport for detecting a jam.
Stackers: There are six stacker pockets.

Diagnostic Features
CE Switch: This switch is used by the CE for checking dynamic reading registration and for marginal checking of the magnetic CB's. When the switch is on, any marginal signal will create an error which stops the machine. The CE can then check the information in the bit registers and in the stacker shift registers with a CE meter.
Integrated Maintenance Package: Trouble-analysis procedures are included that assist the CE in isolating a problem without the use of an oscilloscope.
Error Check Lights: A hopper check, two feed checks and a read check are used to detect jams and read errors. Error checks assist the customer and CE to locate the area of trouble.

5496 Data Recorder

Description

The IBM 5496 Data Recorder is used to provide punched and printed source documents for the new IBM System 3. The output of the 5496 is the new generation small card, punched with a modified BCD (Binary Coded Decimal) code. Utilizing the delay line buffered entry concept, the machine provides complete operator control and allows for error correction before a card is punched. Machine flexibility is further enhanced by the ability to internally "store" four complete programs. Program selection is made by pressing a key on the keyboard corresponding to the desired program level. Both print and verify are standard features on all models.

Special Feature

Self checking feature is offered in both modulus 10 and 11.

Specifications

Card Capacity: Hopper and stacker — 350 cards nominal.

Throughput: Punching, printing, and reading — card incrementing 20 columns per second.

Programs: There are four standard programs. The programs are loaded into the 5496 storage unit by optically reading prepunched cards.

Keyboard: The keyboard has 64 characters with upper and lower shift under program or manual control. A new feature called programmable numeric shift allows punching of numeric characters only. Keying of any character outside the numeric set will cause an error light and lock the keyboard.

Punch Unit: The punch unit has three groups of six punches for punching 3 columns at the same time (one column from each tier e.g. columns 1, 33, and 65).

Print Unit: The print station has three continuously running print wheels for printing information on the upper portion of the card.

Read Unit: A photoelectric read unit is used to read prepunched cards which are to be verified or loaded into memory.

Coding: The 5496 punches cards with the modified 6-bit BCD code (BA8421).

Technology

The machine uses IBM Solid Logic Dense (SLD) technology for smaller, more reliable, functionally packaged logic. There are 33, two wide-two high populated cards mounted on one SLD large board.

These solid state components allow circuit speeds in the nano-second range.

The machine uses a modified SELECTRIC keyboard which employs a new technology called elastic diaphragm switches. In addition it contains all the logic necessary to encode the 64 character set into the modified BCD language.

All information entered from the keyboard or read station is stored in a device called a sonic delay line.

There is one sonic delay line in the 5496. It has a capacity to store 96 words (1 word equals 56 bits) of information.

Diagnostic Features

Documentation: Function and data flow diagrams and charts with analysis guides are available to help isolate a trouble to a function.

Storage Display: The column indicator when used in conjunction with the CE Panel switches can display the entry register or any position of delay line storage.

CE Latch and Indicator: This special latch and indicator allow the CE to display logic levels and build sync points.

Single Wire Logic Probe: This diagnostic feature utilizes two indicator lights mounted on the logic board. These lights and their associated circuitry enable the the CE to display up (+), down (—), changing and floating logic levels.

Checking Circuits

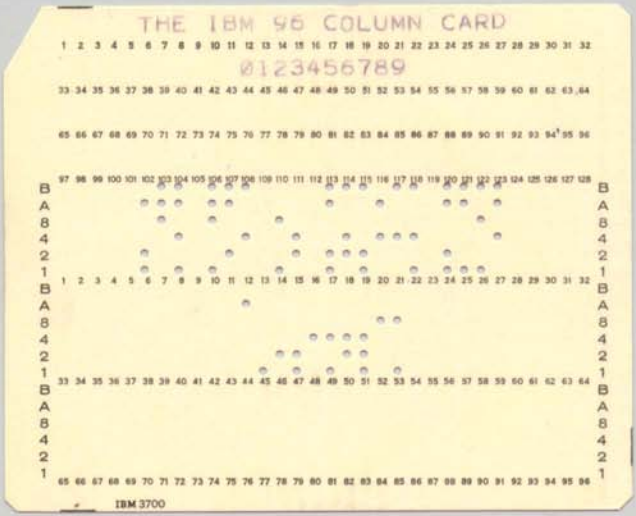
Feed Check: Feed check lamp is used to indicate a card misfeed or card jam.

Four types of card handling malfunctions in the transport are detected and cause a feed check indication:

- Hopper misfeed — a card fails to feed from the hopper or the hopper is empty.
- A card feeds from the hopper but fails to be registered or takes an excessive amount of time to be registered, determined by a fixed logic timer.
- A card fails to cover the read cells a specified number of increments after registration.
- The card fails to clear the read station a specified number of increments after registration.

Error: The error lamp will identify keyboard lockup when caused by a self check error, verify non-compare error or invalid character (program numeric shift).

IBM System/3



IBM System/3

THE IBM 96 COLUMN CARD

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IBM 3700

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