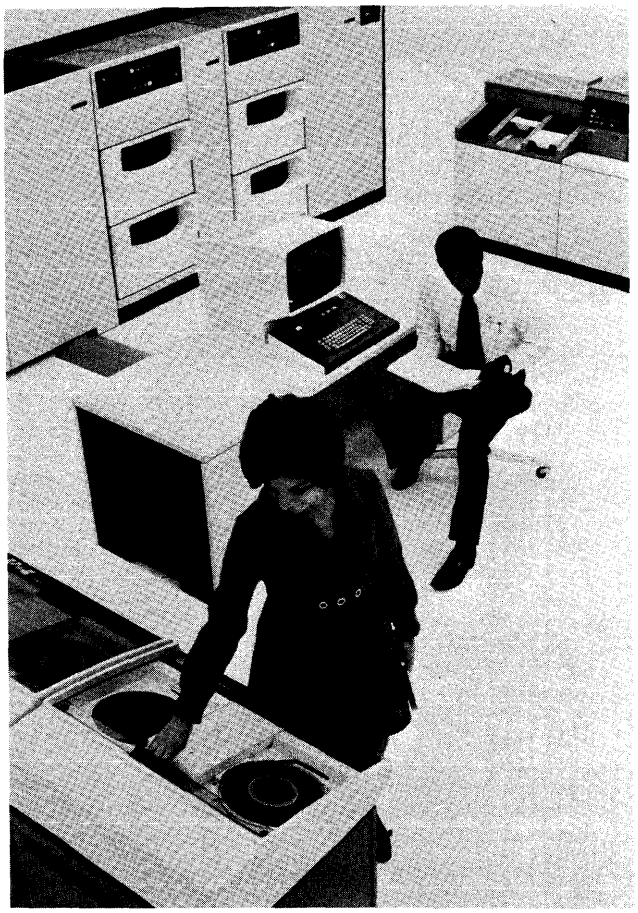
IBM System/370 Model 125



High-speed peripheral equipment for the Model 125 is currently limited to the 3330 Series Disk Storage drives (left rear), which provide up to 400 million bytes of on-line storage, and the 3410/3411 Magnetic Tape Units (left foreground), which provide data rates of up to 80,000 bytes/second.

The Model 125 extends the System/370 line downward while providing most of the capabilities of the larger members. Noteworthy features include distributed processing, 98K or 131K bytes of MOSFET main memory, up to 16 million bytes of virtual storage, and up to 400 million bytes of 3330-style disk storage.

MANAGEMENT SUMMARY

On October 4, 1972, IBM introduced the System/370 Model 125, the eighth model in the expanding System/370 lineup and the smallest announced to date. The Model 125 narrows, but does not completely fill, the broad gap that previously existed between IBM's System/3 and System/370 computer families. Thus, it seems likely that when IBM deems the market conditions right, it will announce either a further downward extension of the System/370 (the long-rumored Model 115?) or an upward extension of the System/3.

The Model 125 is upward-compatible with the larger System/370 processors, offers most of the same processing facilities, has the same virtual storage capabilities, and can use the same DOS/VS and/or DOS software facilities. It continues the IBM trends to MOSFET main memory and toward integrated controllers for nearly all ▷

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, 1133 Westchester Avenue, White Plains, New York 10604.

MODEL: System/370 Model 125.

DATA FORMATS

BASIC UNIT: 8-bit byte. Each byte can represent 1 alphanumeric character, 2 BCD digits, or 8 binary bits. Two consecutive bytes form a "halfword" of 16 bits, while 4 consecutive bytes form a 32-bit "word."

FIXED-POINT OPERANDS: Can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode; 1 halfword (16 bits) or 1 word (32 bits) in binary mode.

FLOATING-POINT OPERANDS: 1 word, consisting of 24-bit fraction and 7-bit hexadecimal exponent, in "short" format; 2 words, consisting of 56-bit fraction and 7-bit hexadecimal exponent, in "long" format; or 4 words in "extended precision" format.

INSTRUCTIONS: 2, 4, or 6 bytes in length, specifying 0, 1, or 2 memory addresses, respectively.

INTERNAL CODE: EBCDIC (Extended Binary-Coded Decimal Interchange Code).

MAIN STORAGE

TYPE: Monolithic integrated circuits (MOSFET).

CAPACITY: Two models of the 3125 Processing Unit are available:

Model FE – 98,304 bytes.
Model G – 131,072 bytes.

CYCLE TIME: 480 nanoseconds per 2-byte access. (Note: CPU cycle time varies from 480 to 1440 nanoseconds, depending on the internal operation being performed.)

CHECKING: All data paths between the central processor and main storage are parity-checked by byte. When data is stored, an error-correcting code is substituted for the parity bits. When the data is retrieved, single-bit errors are detected and corrected automatically, and most multiple-bit errors are detected and signalled so that appropriate program action can be taken.

STORAGE PROTECTION: The Store and Fetch Protection features, which guard against inadvertent overwriting and/or unauthorized reading of data in specified 2048-byte blocks of storage, are standard in Model 125. ▶

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peripheral units, including up to 400 million bytes of high-performance 3330 Series Disk Storage and 22 data communications lines. Moreover, the Model 125 boasts two significant facilities that are not present in the larger Model 135 and 145 systems: a standard operator console with CRT display, and independent "satellite" processors that permit simultaneous instruction processing, input/output processing, and diagnostic/maintenance processing.

The Model 125 provides approximately two-thirds of the internal processing power of the Model 135 at a substantially lower cost. Monthly rental prices for typical Model 125 systems will range from $8,207 to $13,794, with purchase prices ranging from $377,815 to $602,620. Customer shipments are scheduled to begin in April 1973, and the supporting DOS/VS software is scheduled for availability in June 1973. IBM will manufacture the Model 125 in Poughkeepsie, New York; Vimercate, Italy; and Yasu, Japan.

PROCESSOR FEATURES

The Model 125 Processing Unit is program-compatible with the larger System/370 models. It uses the full System/370 instruction set, which adds 18 new instructions to the System/360's already large instruction set. Five of the new instructions facilitate control of the Dynamic Address Translation mechanism that performs the translations between virtual and real storage addresses. The other 13 new instructions help reduce execution time and program storage requirements by enhancing decimal arithmetic performance, eliminating the need for multiple "move" instructions, and facilitating the blocking and unblocking of records.

MOSFET (metal-oxide semiconductor field-effect transistor) main memory is featured in the Model 125, as in the larger Model 158 and 168 Processing Units announced in August 1972. The MOSFET memories are smaller in size, lower in power consumption, and cheaper to produce than the bipolar LSI memories used in System/370 Models 135 and 145. Thus, it has become apparent that MOSFET is IBM's memory technology of the future – and that the bipolar memories were introduced as an interim measure until satisfactory yields could be obtained in mass production of the MOSFET memories.

The Model 125's main memory cycle time is a fast 480 nanoseconds per 2-byte access. Unlike most of today's computers, the Model 125 is available in only two main memory capacities: 98,304 or 131,072 bytes. The 98K size is a practical minimum for virtual storage operation under DOS/VS; and it is likely that even with the larger 131K size, main memory capacity will turn out to be the principal limiting factor on the throughput of most Model 125 installations.

CENTRAL PROCESSOR

REGISTERS: Sixteen 32-bit general registers, used for indexing, base addressing, and as accumulators, plus 4 floating-point arithmetic registers and 16 control registers.

INDIRECT ADDRESSING: None.

INSTRUCTION REPERTOIRE: Consists of the full System/370 instruction set as described in Report 70C-491-04. (Floating-point arithmetic, including extended-precision floating-point, is a no-cost optional feature.)

PERFORMANCE: Typical internal performance of the Model 125 in Basic Control mode is approximately 1.3 to 3.0 times that of the System/360 Model 22 or Model 30 and 2.0 to 4.5 times that of the System/360 Model 25.

RELOADABLE CONTROL STORAGE: All Model 125 central processor operations are controlled by microprogramming. The microprograms for the Instruction Processing Unit (IPU), Service Processor (SVP), and Input/Output Processors (IOP's) reside in discrete MOSFET Reloadable Control Storage (RCS) areas, which are separate from main storage. The IPU, SVP and IOP microprograms are loaded into RCS by means of a small read/write disk drive, the Console File, which contains a removable magnetic "diskette." IBM supplies prewritten diskettes containing all the control microprograms and Field Engineering diagnostics required for a specific installation.

The basic IPU microprogram resides in 12,288 22-bit words of RCS, and one or two additional 4,096-word increments may be added to support optional IPU features. The following table shows the quantities of RCS required to support various combinations of optional features:

	12K Words of RCS				16K Words of RCS				20K Words of RCS		
1401/1440/1460 Compatibility	•				•				•		•
System/360 Model 20 Compatibility		•		•				•		•	
Floating Point (including Extended Precision)			•	•	•		•			•	•
2311 Model 1 Compatibility						•	•	•	•	•	•

DYNAMIC ADDRESS TRANSLATION: This facility, standard in the Model 125, is the mechanism that translates the virtual storage addresses contained in instructions into real main storage addresses as each instruction is executed. A virtual storage space as large as 16,777,216 bytes can be addressed. A two-level address translation process divides the virtual storage space into segments of 65,536 bytes, which are in turn divided into 2,048-byte pages.

Translation between the virtual and real addresses is accomplished by a hardware-implemented table-lookup procedure that accesses tables in main storage which are created and maintained by the operating system. The translation process is speeded up by a group of high-speed registers called the Translation Look-aside Buffer (TLB), which holds recently referenced virtual storage addresses and their real storage equivalents. The translation of addresses contained in the TLB can be accomplished much more rapidly than when references to the page and segment tables in main storage are required.

OPERATIONAL MODES: Model 125 can operate in either the Basic Control (BC) or Extended Control (EC)

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Virtual storage in the Model 125 is handled in the same manner, and with the same 16-million-byte addressing capability, as in the larger System/370 models. Please refer to the main IBM System/370 report, 70C-491-04, for a detailed discussion of the operation, advantages, and disadvantages of virtual storage.

The Model 125 enjoys the distinction of being the first IBM system below the "super-computer" class to employ distributed processing techniques. The Model 125 CPU includes an Instruction Processing Unit (IPU), a Service Processor (SVP), and Input/Output Processors (IOP's), all of which can operate independently and simultaneously. The IPU interprets the program instructions and executes the internal operations of the system. The SVP, located in the operator's console, controls the console operations and handles a variety of diagnostic and error-recovery functions. The IOP's control the system's I/O operations in place of conventional input/output channels; the number of IOP's varies with the configuration and features of each Model 125 installation.

The microprograms that control all the internal operations of the Model 125 Processing Unit reside in Reloadable Control Storage (RCS), a MOSFET memory that is separate from main storage. The IPU, SVP, and IOP's are controlled by separate microprograms that reside in discrete areas of RCS. The microprograms are loaded into RCS via the Console File, a small read/write disk drive that holds a removable magnetic "diskette." The basic Model 125 CPU includes 12,288 22-bit words of RCS to hold the IPU microprogram. Systems that include more than one of the optional compatibility features will require one or two additional 4,096-word increments of RCS.

System/370 features which are standard in the Model 125 Processing Unit include: Interval Timer, Time-of-Day Clock, CPU Timer, Clock Comparator, Store and Fetch Protection, Byte-Oriented Operand feature, Extended Control (EC) mode, Dynamic Address Translation, Channel Indirect Data Addressing, Program Event Recording, main storage error checking and correction, and automatic retry. No-charge options (which may require additional RCS increments) include Floating-Point Arithmetic and the following compatibility features: IBM 1401/1440/1460, System/360 Model 20, 1052, and 2311 Model 1. Optional at extra cost are the External Signals feature, the Multiplexer Channel, and the numerous adapters and attachments required to connect various peripheral and communications devices.

PERIPHERAL EQUIPMENT

From two to four 3330 Series Disk Storage Drives, each capable of storing 100 million bytes of data in a removable 12-disk pack, can be connected directly to a

mode. The BC mode maintains general upward compatibility with the System/360 architecture and programming. In the new EC mode, the Program Status Word (PSW) and the layout of the permanently assigned lower main storage area are altered to support Dynamic Address Translation and other new system control functions; therefore, the new virtual-storage-oriented DOS/VS operating system must be used.

OPTIONAL FEATURES: The Floating-Point feature, a no-cost option, adds 44 instructions to perform floating-point arithmetic in three different modes: short (1-word), long (2-word), and extended precision (4-word).

The External Signals feature provides six distinct external interrupt lines which are independent of the normal data channels and can be used to request and identify an external interrupt response from the processor.

Other Model 125 processor options are described in the sections on Compatibility Features, Input/Output Control, and Communication Control, which follow.

COMPATIBILITY FEATURES: The Model 125 Processing Unit can be equipped with compatibility features and associated emulator routines that enable it to execute programs written for earlier IBM computers. These "integrated emulators" permit emulated programs to be processed along with native-mode System/370 programs in a multiprogramming mix under either DOS or DOS/VS control. In general, their use requires a Model 125 system with I/O devices equivalent to those of the system to be emulated (plus the devices required by the operating system), and with more core storage capacity and processing power. Only the more common peripheral devices (card readers, punches, printers, magnetic tape units, disk drives, and consoles) can be emulated, and certain special and custom features are not supported.

The 1401/1440/1460 Compatibility Feature is a no-charge option that, in combination with special emulator routines, enables a Model 125 to execute programs written for the earlier IBM 1401, 1440, or 1460 computers. A single emulated 1400 Series program can be processed along with one or more native-mode System/370 programs. The 1401/1440/1460 emulator is control-card-compatible with the CS/30 Compatibility Support routine for the System/360.

The System/360 Model 20 Compatibility Feature is a no-charge option that, in combination with a special emulator routine, enables a Model 125 to execute programs written for the IBM System/360 Model 20. Emulated Model 20 CPS, TPS, and/or DPS programs in one or more partitions can be processed concurrently with one or more native-mode System/370 programs. (Note: The 1401/1440/1460 and System/360 Model 20 Compatibility Features are mutually exclusive unless RPQ SU0002 is installed on the Model 125 CPU.)

The 1052 and 2311 Model 1 Compatibility Features are no-charge options that make it possible to use DOS, Version 3 or 4, on the Model 125. The 1052 Compatibility Feature (required for both Versions 3 and 4) permits emulation of the 1052 Printer-Keyboard by the 5213 Console Printer and the Model 125's standard console keyboard. The 2311 Model 1 Compatibility Feature (required for DOS Version 3 only) permits emulation of 2311 Model 1 disk files on 3333/3330 disk files connected to the Model 125. A single 3336 Disk Pack can hold the contents of up to eleven 1316 Packs.

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Model 125 Processing Unit. The smaller, slower 2319 Disk Storage drives that are the mainstays of most Model 135 and 145 installations are not currently available for the Model 125 – a development that is sure to cause further consternation among the independent suppliers of 2314/2319-style disk drives. In view of the large amount of relatively low-cost mass storage provided by the 3330 series drives, IBM is encouraging prospective Model 125 buyers to consider keeping all of their data on-line all the time – a logical first step toward integrated data base processing.

Integrated I/O attachments or adapters permit direct connection of the following input/output devices to a Model 125 Processing Unit:

- A 3504 Card Reader (800 or 1200 cpm).
- Either a 3525 Card Punch (100, 200 or 300 cpm), a 2560 Multi-Function Card Machine (for 80-column cards), or a 5425 Multi-Function Card Machine (for 96-column cards).
- A 1403 Printer (600 or 1100 lpm).
- A 5213 Console Printer (85 char/sec).
- Up to six 3410/3411 Magnetic Tape Units (20KB, 40KB, or 80KB).
- Up to 6 synchronous (BSC) and 16 asynchronous (start-stop) communications lines.

In additional, an optional Multiplexer Channel permits the connection of a variety of other low-speed I/O devices, including paper tape readers and punches, optical mark readers, magnetic character readers, and additional card readers and punches. No Block Multiplexer Channels nor Selector Channels are currently available for the Model 125, however, and the 3330 Series Disk Storage and 3410/3411 Magnetic Tape Units are the only high-speed peripheral devices that can be used in a Model 125 system.

SOFTWARE

Software support for the Model 125 centers on DOS/VS. Announced in August 1972 for delivery in June 1973, DOS/VS is an upward extension of the widely used System/360 DOS that supports virtual storage, permits up to five jobs to be processed simultaneously (compared with the previous three), includes a new relocating loader, and features the POWER spooling facility as built-in function.

Although DOS/VS can support up to 16 million bytes of virtual storage, most installations will get better overall results by choosing to work within a con-

CONSOLE: A keyboard/display operator console is an integral part of the Model 125 Processing Unit. The console contains a typewriter-style keyboard, a CRT display, a complement of switches and lights, the Service Processor, and the Console File that loads the system's microprograms. The CRT can display sixteen 56-character lines of data. Data can be entered via the keyboard, displayed on the CRT for verification, and then directed into main storage or the CPU registers. Storage or register contents are displayed in hexadecimal notation. The keyboard and CRT can also be used as an inquiry terminal.

The 5213 Printer, Model 1, can be connected to the console via the Integrated 5213 Printer Attachment. The 5213 produces printed copies of input and output messages displayed on the CRT at a speed of 85 characters per second. Print line length is a maximum of 125 characters, spaced 10 to the inch, and vertical spacing is 6 lines per inch.

INPUT/OUTPUT CONTROL

In place of conventional I/O channels, Model 125 uses internal Input/Output Processors (IOP's) to control its I/O operations. Each IOP is implemented through microprograms in a discrete Reloadable Control Storage area and can access main storage independently. Thus, attached I/O devices can operate concurrently with devices attached to other IOP's and with internal computing. The number of IOP's depends upon the configuration and features of each Model 125 installation.

From two to four 3330 Series Disk Storage drives can be connected directly to a Model 125 Processing Unit. Optional integrated attachment features permit direct connection of any of the devices described in the "Input/Output Units" section that follows; no separate control units or I/O channels are required.

The optional Multiplexer Channel permits a wide variety of low-speed I/O devices to be connected to a Model 125. This channel is implemented by a microprogrammed IOP and is functionally similar to the Multiplexer Channels in other System/360 and 370 models. It has 8 control unit positions and 32 subchannels. Eight of the subchannels can be shared (i.e., assigned to an I/O control unit that has up to 16 devices attached). The Multiplexer Channel is designed to operate primarily in the byte-interleaved mode, which allows multiple low-speed devices on separate subchannels to operate concurrently. It can also operate in burst mode, which allows only one I/O operation at a time, but burst-mode operation of unbuffered devices is not recommended. The maximum I/O data rate for the Multiplexer Channel is 25,000 bytes/second in byte-interleaved mode and 29,000 bytes/second in burst mode.

No Block Multiplexer Channels nor Selector Channels are available for the Model 125.

MASS STORAGE

3330 SERIES DISK STORAGE: Provides fairly rapid access to large quantities of data stored in interchangeable 3336 Disk Packs. Two, three, or four 3330 series drives, each providing 100 million bytes of on-line storage, can be connected directly to a Model 125 Processing Unit; no I/O channel or attachment feature is required. The first two drives are contained in the 3333 Disk Storage and Control module. The subsystem can be expanded by adding either a 3330 Model 1 Disk Storage module, which contains two

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siderably smaller virtual storage size. And, although DOS/VS provides automatic management of main storage allocation, it requires the user to divide the virtual storage space into a maximum of five fixed partitions and predetermine the programs to be executed in each partition. Thus, DOS/VS simply shifts the fixed-partition requirement of DOS from real storage into virtual storage – and thereby falls far short of delivering all the promised benefits of virtual-storage operation.

Whereas System/370 Model 135 or 145 users need only switch to the Basic Control (System/360) mode to use the older DOS system, Model 125 users who want to run under DOS will need to install the 5213 Console Printer, the 1052 Compatibility Feature, and (for DOS Version 3) the 2311 Model 1 Compatibility Feature.

Model 125 users can take advantage of numerous compilers, assemblers, utility routines, and application programs available for use under DOS/VS and/or DOS. But the Model 125's limited main storage capacity precludes the use of IBM's more powerful OS/VS1, OS/VS2, or VM/370 operating systems and their associated facilities.

MARKET ROLE

IBM is placing primary marketing emphasis on the Model 125 as the growth system for System/360 Model 22 or 25 users who need to handle increased workloads or add applications. In typical commercial applications, the Model 125 in Basic Control mode delivers approximately 1.3 to 3.0 times the internal speed of a Model 22 and approximately 2.0 to 4.5 times the internal speed of a Model 25. Moreover, a 98K Model 125 system with 200 million bytes of 3330 Series Disk Storage (2 drives) can be rented or purchased for about the same price as a 49K Model 25 system with 29 million bytes of 2311 Disk Storage (4 drives).

Users of the System/360 Model 30 are certain to view the Model 125 with great interest. For them, the new model offers significantly higher performance together with, in many cases, modest reductions in equipment costs. IBM, of course, is not likely to encourage this type of conversion unless the alternative is loss of the account to another manufacturer. (Before moving up to the System/370, users of all current IBM computers – and especially Model 30 users – owe it to themselves to carefully investigate the numerous possibilities for upgrading their present systems and/or reducing their costs by utilizing independent disk and tape drives, add-on main memories, proprietary software enhancements, third-party leasing, etc.)

Users of the IBM System/360 Model 20 and 1401, 1440, and 1460 computers can also take advantage of drives, or the newly announced 3330 Model 2, which contains one drive. Each drive is mounted in a powered drawer for operating convenience.

Each 3336 Disk Pack contains 12 disks. Nineteen disk surfaces are used for data recording, and a 20th surface holds prerecorded data that controls seeking, position sensing, and clocking. Each disk pack holds up to 100,018,000 bytes of data. Each data track has a capacity of 13,030 bytes, and each of the 404 data cylinders holds up to 247,570 bytes (19 tracks). Head movement time ranges from 10 to 55 milliseconds and averages 30 for random accesses. Average rotational delay is 8.4 milliseconds, and data transfer rate is 806,000 bytes per second. A Command Retry facility enables the 3330 subsystem to recover from many errors without the use of time-consuming error recovery programs. Error correction coding circuitry in the control unit permits detection and correction of bursts of errors up to 11 bits in length on a single track.

INPUT/OUTPUT UNITS

3410/3411 MAGNETIC TAPE SUBSYSTEM: These compact, low-cost tape units, designed primarily to bring magnetic tape capabilities to the small-scale IBM System/3 Model 10, are also available for use with System/370 Models 125 through 158. The 3410 is a tape unit only, while the 3411 contains both a tape unit and the subsystem control unit. The compact, waist-high cabinets are cable-connected to one another at the front corners, making it possible to place them side by side or at any angle up to 90 degrees to one another. The 3410 and 3411 are available in three models, whose principal characteristics are as follows:

	Model 1	Model 2	Model 3
Tape speed, inches/sec	12.5	25	50
Recording density, bpi	1600	1600/800*	1600/800*
Date rate, bytes/sec:			
At 1600 bpi (phase-encoded)	20,000	40,000	80,000
At 800 bpi (NRZI)	Not avail.	20,000*	40,000*
Inter-block gap, inches	0.6	0.6	0.6
Rewind time, minutes/2400' reel	3	3	2

* Requires Dual Density feature.

All three models use half-inch tape recorded in the standard IBM 9-track formats. On a System/370, a 3411 Model 1 Magnetic Tape Unit and Control can accommodate up to three additional 3410 Model 1 Magnetic Tape Units for a maximum subsystem capacity of four tape drives. A 3411 Model 2 can control up to five additional 3410 Model 2 units, and a 3411 Model 3 can control up to five additional 3411 Model 3 units. Models cannot be intermixed within a subsystem. Every 3410 and 3411 tape unit must be equipped with either the Single Density (1600 bpi) or Dual Density (1600 or 800 bpi) feature; the Dual Density capability is not available for the Model 1 units. A System/370 Model 125 Attachment is required on the 3411 Control Unit, and a 3411 Magnetic Tape Adapter is required on the Model 125 Processing Unit.

Features of the 3410/3411 subsystem include single-capstan drive, linear rewind, simplified tape threading, and a push-pull quick-release latch. As in the high-performance IBM 3803/3420 subsystem, the tape units are connected to the control unit in radial rather than series fashion to facilitate maintenance. Only digital signals are transmitted across the interface to reduce the sensitivity to noise.

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the Model 125's improved performance capabilities through the use of the integrated emulation features.

IBM is also billing the Model 125 as the logical growth system for large System/3 and 1130 installations, but no emulation features are available to help smooth the conversion process for users of these systems. Although IBM offers upward-compatible RPG II and FORTRAN compilers for the Model 125, System/3 and 1130 users will encounter numerous differences in system control, data management, and operational characteristics which could hamper conversions to the System/370. Another key consideration for most users of the Model 20, System/3, and 1130 systems is that the jump to a Model 125 would be a large and expensive one – probably well beyond their economic means and performance needs. The minimum Model 125 system rental of about $8,000 per month is more than twice the average monthly rental of these smaller IBM systems. Thus, a significant gap remains in IBM's current product line, and it seems reasonable to expect that it will soon be filled with a more suitable upgrade system for IBM's thousands of small computer users.

The appeal of the Model 125, like that of the larger System/370 models, is by no means limited to current users of IBM computers. The Model 125 offers a combination of virtues that few buyers of small-to-medium-scale computers can afford to ignore: impressive price/performance, virtual storage, advanced hardware technology, high-performance mass storage, and largely proven software – plus the IBM nameplate and reputation, whose importance to many buyers could hardly be overemphasized. Against these virtues, the prospective buyer must weigh the disadvantages of the Model 125's unbundled support, limited main storage capacity, and relatively inefficient software. On balance, it's safe to predict that the Model 125 will be by far the most widely installed computer in its price class during the next few years. □

3504 CARD READER: Reads standard 80-column cards at either 800 cpm (Model A1) or 1200 cpm (Model A2). Connects directly to a Model 125 Processing Unit via the Integrated 3504 Card Reader Attachment. Functionally identical with the 3505 Card Reader used with System/370 Models 135 through 195. Reads cards photoelectrically, in column-by-column fashion, in either EBCDIC or card image mode. Vacuum-assisted friction feeding is used in place of the conventional "picker knife" feeding. If a card fails to feed, three retries are made automatically before a misfeed indication is given. The 3504 has a 3000-card file feed hopper and two 1750-card stackers. Whenever one stacker becomes full, cards are automatically directed to the other stacker while the operator empties the first one. A third, program-selectable 1750-card stacker is optional.

The Read Column Eliminate capability, standard on the 3504, suppresses the reading (and checking) of data from specified card columns. The optional Optical Mark Read feature permits the reading of up to 40 columns of information marked on the cards with ordinary pencils or preprinted with nonreflective ink; both marked fields and punched fields can be read during a single pass. The optional 51/80-Column Interchangeable Read Feed, for Model A2 only, permits the operator to adjust the feed hopper and stackers so that either 51-column or 80-column cards can be read at 1200 cpm. First customer shipments of the 3504 are scheduled for April 1973.

3525 CARD PUNCH: Punches standard 80-column cards at 100 cpm (Model P1), 200 cpm (Model P2), or 300 cpm (Model P3). Punches a row at a time, in either EBCDIC or card image mode. Can be connected directly to a Model 125 Processing Unit via the Integrated 3525 Card Punch Attachment; only one 3525 can be attached in this manner, and it cannot coexist with a directly connected 2560 MFCM or 5425 MFCU. The 3525 can alternatively be connected to a Model 125 through a 3505 Card Reader (Model B1 or B2) attached via the Multiplexer Channel.

The 3525 has a 1200-card feed hopper, two program-selectable 1200-card stackers, and a 200-card reject stacker. When a punching error is detected, the error card is directed to the reject stacker and the contents of the punch buffer are automatically repunched into the next card. If the retry is successful, the correct card is also routed to the error stacker to aid in diagnosing the malfunction. Finally, a third card is punched with the same data and stacked normally.

An optional Card Print unit for the 3525 uses engraved type slugs to print data on the cards in either an EBCDIC or ASCII 64-character set. The Two-Line Card Print feature prints one or two lines of up to 64 characters on each card during a single pass at the rated punching speed. Alternatively, the Multi-Line Card Print feature permits up to 25 lines, each 64 characters in length, to be printed on each card during a single pass. Card speeds are considerably reduced when more than 2 lines are printed; when all 25 lines are printed, the speed drops to 24 cpm for Model P1 and 29 cpm for Models P2 and P3.

The optional Card Read feature for the 3525 provides a parallel photoelectric reading station ahead of the punching station. The feature includes the Read Column Eliminate capability, which permits suppression of the reading (and checking) of data from specified card columns. Reading, punching, and printing operations can be performed on each card during a single pass.

2560 MULTI-FUNCTION CARD MACHINE (MFCM), MODEL A1: Combines the functions of an 80-column card reader, punch, collator, and interpreter in one unit. Reads at 500 cpm, punches at 160 columns per second, and (with the optional Card Print feature) prints on the cards at 140 print positions per second. Has two 1200-card feed hoppers and five 1300-card radial stackers. Cards can be fed from either hopper and directed to any stacker. One 2560 can be directly connected to a Model 125 via the Integrated 2560 Attachment; it cannot coexist with a directly connected 3525 Card Punch or 5425 MFCU.

The optional Card Print feature enables the 2560 to print 2, 4, or 6 lines on a card, operator-adjustable to any of 25 line positions. There are 64 alphanumeric print positions per line, spaced 10 to the inch. The 2560 Card Print Control feature is a prerequisite on the Model 125.

5425 MULTI-FUNCTION CARD UNIT (MFCU): Combines the functions of a 96-column card reader, punch,

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collator, and interpreter in a single unit. Has two 2000-card feed hoppers and four 600-card radial stackers. Cards fed from either or both hoppers can be read, punched, printed, and directed to any of the four stackers under program control. One 5425 can be directly connected to a Model 125 via the Integrated 5425 Attachment; it cannot coexist with a directly connected 3525 Card Punch or 2560 MFCM. Either the 1403 Printer/5425 MFCU Power Prerequisite or the 5425 MFCU Power Prerequisite is required on the Model 125, depending on whether or not a 1403 Printer is also installed.

The 5425—like the functionally similar 5424 MFCU used in the System/3—is available in two models. Cards are read serially at 250 cpm in Model A1 and 500 cpm in Model A2. Punching is performed serially at 60 cpm in Model A1 and 120 cpm in Model A2. Printing occurs at a speed of 60 cpm in Model A1 and 120 cpm in Model A2 when printing in any or all of the first three line positions on each card. If the fourth (lower) line position is used, the printing speed drops to 48 cpm for Model A1 and 96 cpm for Model A2. Each of the 4 lines can hold up to 32 printed characters.

In contrast to the 6-bit, 64-character code used in the System/3, the 5425 reads and punches an 8-row code representing a 256-character set. Eight-row punching in columns 33 through 96 can result in overpunching of print positions 65 through 128. Characters printed by the 5425 are a 64-character set that corresponds to a 6-bit subset of the 8-bit card code. A new 8-Bit Read/Punch Feature for the 5496 Data Recorder (Report 70D-491-22) will provide a limited capability for creating (through multi-punch keying) 96-column program or data cards using the 8-bit code structure. Customer shipments of the 5425 MFCU are scheduled to begin in December 1973.

1403 PRINTER: Provides high-quality printed output by means of a horizontal chain or train mechanism. The standard character set contains 48 characters, and the Universal Character Set (a no-charge option for Model 2 or N1 only) permits up to 240 characters to be printed. Line spacing of 6 or 8 lines per inch is operator-controlled. Standard skipping speed is 33 inches per second; a dual-speed carriage in Models 2 and N1 permits a speed of 75 inches per second on skips of more than 8 lines.

A single 1403 Printer, Model 2, 7, or N1, can be connected directly to a Model 125 via the integrated attachment and power features listed below. Other 1403 printers can be connected via the Multiplexer Channel and a 2821 Control Unit. Characteristics of the three models are as follows:

Model 2: 600 lpm (750 lpm maximum with UCS option), 132 print positions; Features 4505, 4662, and 4667 are required on the Model 125 for direct connection.

Model 7: 600 lpm, 120 print positions; Features 4505 and 4667 are required on the Model 125 for direct connection.

Model N1: 1100 lpm (1400 lpm maximum with UCS option), 132 print positions; Features 4505, 4662, 4667, and 4668 are required on the Model 125 for direct connection.

OTHER INPUT/OUTPUT UNITS: The following devices can be connected to a Model 125 via the optional Multiplexer Channel. Please refer to Report 70C-491-04 for their characteristics and prices.

1442 Card Read Punch, Model N1
1442 Card Punch, Model N2
2501 Card Reader, Model B1 or B2
2520 Card Read Punch, Model B1
2520 Card Punch, Model B2 or B3
2540 Card Read Punch (requires 2821 Control Unit)
2596 Card Read Punch (96-column)
3505 Card Reader, Model B1 or B2
1443 Printer, Model N1
1017 Paper Tape Reader (requires 2826 Control)
1018 Paper Tape Punch (requires 2826 Control)
2671 Paper Tape Reader (requires 2822 Control)
1255 Magnetic Character Reader
1259 Magnetic Character Reader
1419 Magnetic Character Reader
3881 Optical Mark Reader
2495 Tape Cartridge Reader

COMMUNICATION CONTROL

INTEGRATED COMMUNICATIONS ADAPTER (ICA): This optional feature for the Model 125 Processing Unit provides the basic control storage and common circuits for direct connection of up to 6 synchronous (BSC) and 16 asynchronous communications lines, depending on the line speeds. The ICA combines the functions of a Byte Multiplexer Channel and a communications control unit. Lines connected via the ICA are addressed and controlled as if they were connected to the Model 125's Multiplexer Channel via a 2703 Transmission Control.

The basic ICA can control either up to 16 asynchronous lines or up to 6 BSC lines. All combinations of BSC and asynchronous lines require the ICA Extension feature. Additional features are required to create appropriate line interfaces for the individual lines, and the associated configuration rules are quite complex. Standard facilities of the ICA for BSC lines include Autopoll, multipoint central station functions, multipoint tributary station functions, EBCDIC transparent mode, and either EBCDIC or ASCII code; the Autopoll and multipoint central station functions are provided for asynchronous lines as well.

Asynchronous line speeds can range from 45.5 to 600 bits/second (though the maximum number of 600-bps lines on the ICA cannot exceed 8). Synchronous line speeds can range from 600 to 50,000 bits/second; but only one high-speed line (above 7200 bps) can be connected and must not be operated concurrently with any other line on the ICA. An ICA-equipped Model 125 can communicate with virtually the full gamut of IBM computers and communications terminals.

OTHER COMMUNICATIONS CONTROLLERS: The IBM 2701, 2702, 2703, and/or 3705 communications controllers can be connected to the Multiplexer Channel of a Model 125 and used in place of, or in addition to, the Integrated Communications Adapter. These controllers are described in Reports 70C-491-04 and 70D-491-31.

SOFTWARE

DOS/VS (Disk Operating System/Virtual Storage) is the primary operating system for the Model 125. In addition to all the facilities described in Report 70C-491-04, DOS/VS has been extended to provide software support for all the specialized hardware facilities of the Model 125. The DOS/VS extensions consist of support for: (1) the Model 125's keyboard/display operator console, (2) the 2560 MFCM, (3) the 5425 MFCU, (4) the 3504 Card Reader and

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3525 Card Punch, (5) the Integrated Communications Adapter, (6) the 1401/1440/1460 Emulator, (7) the System/360 Model 20 Emulator, and (8) the Model 125's improved diagnostic and error recovery functions. DOS/VS, however, does not support the Rotational Position Sensing capability of the 3330 Disk Storage drives.

The minimum system supported by DOS/VS is a Model 125 with 98K bytes. The minimum resident memory requirement for the DOS/VS Supervisor is 24K bytes. All of the DOS/VS facilities mentioned here are scheduled to become available in June 1973, except for the 5425 MFCU support, which is scheduled for December 1973.

IBM's older DOS (Disk Operating System), Version 3 or 4, can be used on a Model 125 if certain configuration requirements are met and the system is operated only in the Basic Control mode. Operation under DOS Version 4 (Release 27) requires the 5213 Console Printer and the 1052 Compatibility Feature, since DOS does not support the Model 125's keyboard/display operator console. Operation under DOS Version 3 (Releases 21 through 26) requires the 2311 Model 1 Compatibility Feature as well as the 5213 Console Printer and 1052 Compatibility Feature. DOS Version 4 supports the integrated emulators for the 1401/1440/1460 and System/360 Model 20, but Version 3 does not.

A wide variety of IBM compilers, assemblers, utilities, and application programs can be run on the Model 125 under DOS/VS and/or DOS. Please refer to Report 70C-491-04 for their characteristics and prices.

PRICING

EQUIPMENT: The following systems illustrate typical Model 125 configurations. All necessary control units and adapters are included in the indicated prices. The quoted rental prices are for short-term leases and include equipment maintenance.

SMALL DISK SYSTEM: Consists of 98K Model 125 Processing Unit, 3333 Disk Storage and Control (2 drives, 200 million bytes total), 3504 Model A1 Card Reader (800 cpm), 3525 Model P1 Card Punch (100 cpm), and 1403 Model 7 Printer (600 lpm). Monthly rental and purchase prices are approximately $8,460 and $391,000, respectively.

EXPANDED TAPE/DISK SYSTEM: Consists of 131K Model 125 Processing Unit, 3333 Disk Storage and Control plus 3330 Model 1 Disk Storage module (4 drives, 400 million bytes total), six 3410/3411 Model 3 Magnetic Tape Units and Control (80KB), 3504 Model A2 Card Reader (1200 cpm), 3525 Model P3 Card Punch (300 cpm), 1403 Model N1 Printer (1100 lpm), and 5213 Console Printer. Monthly rental and purchase prices are approximately $13,600 and $593,000, respectively.

SOFTWARE: System/360 software which was being distributed by the IBM Program Library as of June 23, 1969, is available to System/370 users at no additional charge. All subsequent IBM programming announcements (except for certain modifications and improvements of existing IBM programs) are designated as either System Control Programming or Program Products.

System Control Programming provides functions which are fundamental to the operation and maintenance of a system (e.g., loading, scheduling, supervising, and data management) and is available without charge.

Program Products are related to the application of a system to user tasks (e.g., compilers, utility programs, and application programs). These are offered on an individual-charge basis, as listed under "Software Prices."

Also available on an individual-charge basis, but without centralized IBM programming support, are approximately 34 Field-Developed Programs and 7 Installed User Programs for the System/370.

SUPPORT: IBM Systems Engineering assistance is available to System/370 Model 125 users at a basic rate of $30.00 per hour.

EDUCATION: IBM "Professional Courses" are now individually priced. System Features Instruction is offered to users of IBM data processing equipment at no charge. Customer Executive Seminars, Industry Seminars, and promotional sessions are still offered at no charge by IBM invitation.

CONTRACT TERMS: The standard IBM rental contract includes equipment maintenance and entitles the customer to up to 176 hours of billable time per month. Time used in excess of that amount is charged for, on all machines equipped with meters, at an extra-use rate. This rate, for most System/370 components, is 10% of the basic hourly rate (i.e., 10% of 1/176 of the monthly rental for each hour of extra use).

IBM's Fixed-Term Lease Plan, introduced on June 1, 1971, offers price reductions of 8 or 16 percent from the short-term monthly rental rates to users willing to sign a 12-month or 24-month contract, respectively. The Fixed-Term Leases apply to nearly all of the System/370 magnetic tape, disk, drum, and printer units and to the associated control units and features, but not to the mainframes or other types of peripheral devices. Extra-use charges are eliminated under these leases, and up to two years of purchase option accruals are available. The user has the option to extend his lease for an indefinite number of additional 12-month or 24-month periods and for one shorter period under the same terms. Users who elect to cancel a Fixed-Term Lease will be assessed a penalty of 2.5 times the monthly rental on a 12-month contract or 5 times the monthly rental on a 24-month contract (or the remaining amount due, whichever is less).

IBM's Extended-Term Lease Plan, introduced with the 3705 Communications Controller on March 1, 1972, is a more flexible lease plan under which "selected machines" will be offered. The plan has a basic contract period of 24 months and offers monthly charges approximately 15% below the short-term rental prices. Significant provisions of the Extended-Term Plan include: elimination of additional-use charges, unlimited one-year extensions after the initial contract period, single extension of less than one year, purchase option credits for 24 months, protection against price increases during the contract period, and upgrading of installed machines (through field-installable features and model changes) without termination charges. Charges for early termination decline from a maximum of five times the monthly charge (for the first six months of the lease) to the smaller of two times the monthly charge or the remaining amount due (during the last six months of the initial contract period or during any extension). ■

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint. *	Rental (short-term lease)*
PROCESSOR AND MAIN STORAGE				
3125	Processing Unit (including Operator Console):			
	Model FE; 98,304 bytes	231,600	290.00	4,775
	Model G; 131,072 bytes	241,300	295.00	4,975
PROCESSOR FEATURES				
3898	External Signals	4,850	1.00	100
3910	Floating Point (including Extended Precision)	No charge	No charge	No charge
4101	First 4K-Word Control Storage Increment	3,650	1.50	75
4102	Second 4K-Word Control Storage Increment	3,650	1.50	75
4457	1401/1440/1460 Compatibility	No charge	No charge	No charge
4500	5425 Card Unit Power Supply	7,750	11.00	160
4505	1403 Printer/5425 Card Unit Power Prerequisite	13,600	30.00	280
4662	Integrated 1403 Model 2/N1 Printer Attachment	500	1.00	10
4667	Integrated 1403 Model 2/7/N1 Printer Attachment	6,300	10.00	130
4668	Integrated 1403 Model N1 Printer Attachment	250	1.00	5
4670	Integrated 2560 Model A1 MFCM Attachment	6,800	10.00	140
4674	2560 Card Print Control	1,450	2.00	30
4675	3411 Magnetic Tape Adapter	4,850	3.00	100
4680	Integrated 3504 Card Reader Attachment	3,150	6.50	65
4685	Integrated 3525 Card Punch Attachment	3,900	9.00	80
4692	Integrated 5213 Console Printer Attachment	4,850	3.00	100
4693	3525 Card Print Control	2,900	2.50	60
4695	Integrated 5425 MFCU Attachment	6,800	16.00	140
5248	Multiplexer Channel	9,700	19.00	200
7520	System/360 Model 20 Compatibility	No charge	No charge	No charge
8005	1052 Compatibility	No charge	No charge	No charge
8040	2311 Model 1 Compatibility	No charge	No charge	No charge
4640	Integrated Communications Adapter	9,950	21.00	205
4641	Integrated Communications Adapter Extension	3,650	1.50	75
1201	Asynchronous Line Group 1 (ALG 1)	1,950	3.00	40
1202	Asynchronous Line Group 2 (ALG 2)	1,950	3.00	40
1231	Asynchronous Line, Medium-Speed, ALG 1	1,950	2.50	40
1232	Asynchronous Line, Medium-Speed, ALG 2	1,950	2.50	40
1241	Asynchronous Line Pair, Low-Speed, ALG 1	2,650	3.50	55
1242	Asynchronous Line Pair, Low-Speed, ALG 2	2,650	3.50	55
1291-1296	Auto-Call Adapter (per line position)	950	1.50	20
4743	IBM Leased Line Adapter	490	2.50	14
	IBM 1200-bps Line Adapter:			
4781	Non-Switched	525	2.50	15
4782	Switched with Auto-Answer	700	3.00	20
4791	Switched with Auto-Answer and Auto-Call	2,275	10.00	65
4792	Line Adapter Base 2	1,200	2.00	25
4793	Line Adapter Base 3	1,200	2.00	25
7100	Synchronous Line Group	1,950	3.00	40
7121	Synchronous Line, High-Speed	4,850	7.00	100
7131	Synchronous Line, Low-Load, First	4,850	7.00	100
7132	Synchronous Line, Low-Load, Second	4,850	7.00	100
7141-7144	Synchronous Line, Medium-Speed with Clock (per line)	2,650	3.50	55
7151-7154	Synchronous Line, Medium-Speed (per line)	2,200	3.00	45
7881	Telegraph Line Pair, ALG 1	2,650	7.50	55
7882	Telegraph Line Pair, ALG 2	2,650	7.50	55
INTEGRATED PERIPHERAL EQUIPMENT				
3333	Disk Storage and Control; 2 drives, 200 million bytes (also controls one 3330, either model)	65,000	200.00	1,627 (2)
3330	Disk Storage:			
	Model 1; 2 drives, 200 million bytes	51,940	170.00	1,300 (1,2)
	Model 2; 1 drive, 100 million bytes	31,000	100.00	770 (2)

* Rental prices include equipment maintenance.

(1) Also available under IBM's Fixed-Term Lease Plan, at a discount of 8% for a 12-month lease or 16% for a 24-month lease.

(2) Also available under IBM's Extended-Term Lease Plan, at a discount of approximately 15% for a 24-month lease.

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (short-term lease)*
INTEGRATED PERIPHERAL EQUIPMENT (CONT.)				
3410	Magnetic Tape Unit:			
	Model 1; 20 KB	7,700	45.00	185 (1)
	Model 2; 40/20 KB	10,300	50.00	245 (1)
	Model 3; 80/40 KB	12,800	55.00	305 (1)
3411	Magnetic Tape Unit and Control:			
	Model 1; 20 KB	17,000	70.00	405 (1)
	Model 2; 40/20 KB	21,600	75.00	515 (1)
	Model 3; 80/40 KB	26,300	80.00	625 (1)
3211	Single Density Feature (for 3410 & 3411)	2,500	7.50	55 (1)
3221	Dual Density Feature (for 3410 & 3411, Models 2 & 3 only)	3,600	27.00	80 (1)
7361	System/370 Model 125 Attachment (required on 3411)			
2560	Multi-Function Card Machine, Model A1; reads 500 cpm, punches 160 col/sec	27,055	97.00	615
	Card Print Feature for 2560 Model A1:			
1575	First Two Lines	5,880	14.00	135
1576	Second Two Lines	5,880	14.00	135
1577	Third Two Lines	5,880	14.00	135
3504	Card Reader:			
	Model A1; 800 cpm	20,000	75.00	470 (2)
	Model A2; 1200 cpm	21,000	100.00	570 (2)
3921	51/80-Column Interchangeable Read Feed (for 3504 Model A2 only)	5,000	37.00	125 (2)
5450	Optical Mark Read Feature (for 3504)	7,950	35.00	184 (2)
6555	Selective Stacker Feature (for 3504)	2,250	7.00	49 (2)
3525	Card Punch:			
	Model P1; 100 cpm	20,000	60.00	400
	Model P2; 200 cpm	20,800	80.00	505
	Model P3; 300 cpm	21,600	100.00	610
1533	Card Read Feature (for 3525)	6,000	15.00	120
5272	Multi-Line Card Print (for 3525)	14,220	83.00	350
8338	Two-Line Card Print (for 3525)	13,920	68.00	290
5425	Multi-Function Card Unit:			
	Model A1; reads 250 cpm, punches 60 cpm, prints 60 cpm	18,000	150.00	570 (2)
	Model A2; reads 500 cpm, punches 120 cpm, prints 120 cpm	22,000	295.00	740 (2)
1403	Printer:			
	Model 2; 600 lpm, 132 print positions	28,030	171.00	750 (1)
	Model 7; 600 lpm, 120 print positions	26,960	133.00	630 (1)
	Model N1; 1100 lpm, 132 print positions	33,970	197.00	875 (1)
1416	Interchangeable Train Cartridge (required for 1403 Model N1)	2,910	Time & mat'ls.	97
4740	Interchangeable Chain Cartridge Adapter (optional for 1403 Model 2 or 7)	2,580	No charge	73 (1)
5213	Printer; 85 char/sec.	6,200	48.00	160

* Rental prices include equipment maintenance.

(1) Also available under IBM's Fixed-Term Lease Plan, at a discount of 8% for a 12-month lease or 16% for a 24-month lease.

(2) Also available under IBM's Extended-Term Lease Plan, at a discount of approximately 15% for a 24-month lease.

NOTE: Please refer to the price list at the end of Report 70C-491-04 (IBM System/370) for prices of the additional peripheral equipment and IBM Program Products that can be used with the Model 125.